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DISRAELI KOBAK, M.D., Editor

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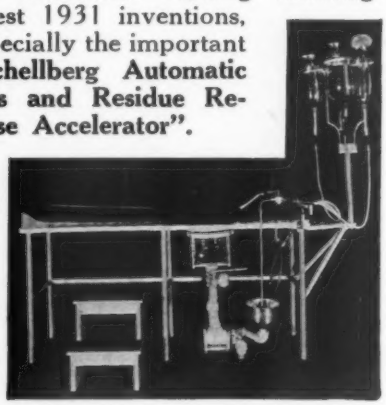

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1. A method for producing hyperpyrexia in man has been described.
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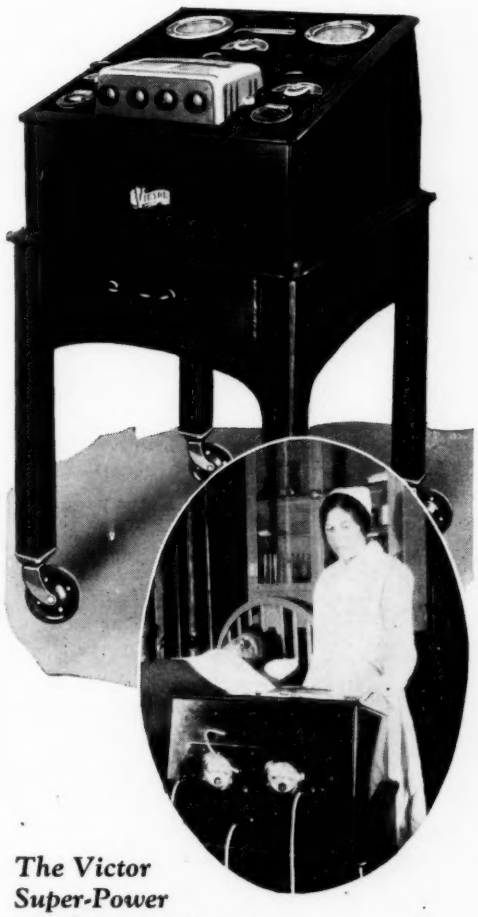
4. No serious harm resulted to these patients from the treatment and there were no deaths in this series directly or indirectly ascribable to the treatment.
5. Certain physiologic phenomena associated with hyperpyrexia produced by diathermy have been described.

—*Clarence A. Neymann, M.D., and S. L. Osborne, B.P.E.: The treatment of Dementia Paralytica, with Hyperpyrexia Produced by Diathermy. From the Depts. of Neuropsychiatry and Physical Therapy, Northwestern University Medical School, and the Cook County Psychopathic Hospital, Chicago. Jour. A.M.A. Vol. 96, No. 1, Jan. 3, 1931.*

The preference for diathermy in this form of treatment is because it offers definite advantages over the method of injecting pathogenic organisms, with the attendant uncertainty of their secondary effects.

A reprint of the article by Neymann and Osborne, and other literature on this subject, will be sent on request, together with a description of the Victor Super-Power Diathermy Apparatus, designed especially for producing therapeutic fever.



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Discussing the treatment of subacute and chronic cases, the author states:

> "For this period of treatment I know of no other analgesic so efficacious as Mono-Iodo-Cinchophen. This drug contains Cinchophen linked with Iodine, which is supposedly liberated as nascent Iodine when ingested. Thus the analgesic power of Cinchophen is obtained, plus the anabolizing effect of the Iodine. Metabolism is speeded up, thereby producing a dual effect. The dose is one or two capsules after each meal.
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*"The Treatment of Arthritis"—Dr. Stanley Fahlstrom, Feb., 1931, issue of Archives of Physical Therapy, X-Ray, Radium with International Abstract, from the Arthritis Clinic, Dept. of Medicine, Loyola University School of Medicine and Mercy Hospital, Chicago.

THE RADIOTHERM: ITS CONSTRUCTION AND PRINCIPLES OF OPERATION*

K. C. DeWALT

Vacuum Tube Engineering Department,
General Electric Company

SCHENECTADY, N. Y.

Introduction

The present apparatus for the production of artificial fever is a development of a small induction type of heater which Dr. W. R. Whitney[1] once used in an attempt to grow artificial galls on plant stems. Later an electromagnetic field at very high frequencies was used and the effects produced in rats and mice were studied. Since the high frequency magnetic field is suitable for heating some good conductors and the electrostatic field is suitable for heating poor conductors and dielectrics, the electrostatic field was chosen as the one best suited for the simple study of artificial fevers.

Shortly after these early experiments, Dr. Whitney observed an elevation in the body temperature of men working in the field of high power short wave oscillators. Since then, considerable experimental work has been done to adopt this energy to the production of artificial fevers.

Various forms of electrical diathermy have been used for years. These methods required the direct application of electrodes to the body and had several limitations. The major of these was the discomfort to the patient. With the new equipment, as used in radiotherapy, it is necessary only to place the body in the space between two insulated plates and the temperature may be raised at a rate and to an amount dependent only on the control of the generating apparatus.

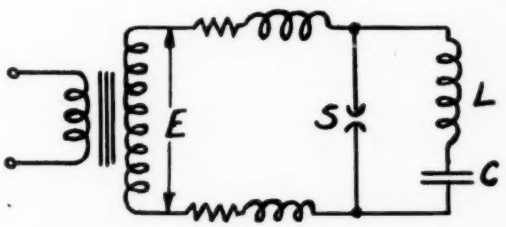
Production of Damped Oscillations

It might be well to note here some of the characteristics of the generating apparatus used for diathermy and for radiotherapy. In diathermy apparatus, an alternating voltage, E, is applied to a condenser and spark gap in series with a coil as shown by Fig. 1a.

The gap, S, is adjusted to break down slightly before the condenser, C, becomes full charged and when this occurs, the condenser discharges through the gap and inductance, producing a high frequency wave train; the frequency of which is determined by the inductance, L, and the capacity, C, of the circuit,

$$f = \frac{1}{2\pi\sqrt{LC}} \text{ cycles per second}$$

when L = henries, C = farads. These electric oscillations are what are known as damped waves in which each succeeding amplitude is decreased a definite amount, determined by the circuit constants, until the amplitude is essentially zero. This all occurs in a small fraction of a second (perhaps one thousandth of a second), in some cases only five or ten cycles occurring during the discharge. The wave trains are illustrated by Fig. 1b. This shows that two



a.

b.

Fig. 1

wave trains occur during each cycle and that the power of such an oscillation is directly dependent on the number of wave trains or the number of alternations in the low frequency power supply. High efficiencies, therefore, cannot be expected from highly damped oscillations.

---

* Read by invitation at the New York Physical Therapy Society, New York, October 3rd, 1930.

1 Vice-President of the General Electric Company, in Charge of Research.

The relation of frequency to wavelength in an alternating wave may well be illustrated by a simple analogy from the observation of waves on a lake. If we were to stand near the end of a long dock (Fig. 2) and measure the distance between successive crests as the waves come to shore we would have the wavelength, as λ.

Then if we were to count the number of crests that pass during a unit of time, we would have the frequency of passage. Supposing these to be twenty waves per minute of ten feet wavelength, we can calculate the velocity of propagation as two hundred feet per minute. The same is true for radio waves, except here we have a constant velocity of propagation of three hundred million meters per second—the velocity of light waves. Therefore, the frequency, or

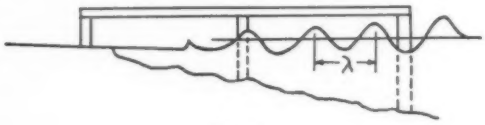


Fig. 2

number of waves per second, may be easily obtained when the wavelength, or distance between crests is known. The wavelength is usually expressed in meters and the frequency as cycles per second. The following relation defines these quantities:

$$f\ (\text{frequency}) = \frac{300{,}000{,}000}{\lambda\ (\text{wavelength})}$$

Several methods for determining the wavelength are known—the most useful being a tuned circuit, the constants of which are readily calculable (Fig. 3). The circuit may be brought close to the oscillator, and the condenser, C, adjusted for a maximum reading of the indicating meter.

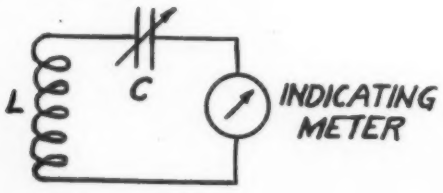


Fig. 3

The wavelength is then given by the formula

$$= 2\pi \bar{C}\sqrt{LC}$$

wherein $\bar{C}$ = velocity of light waves, L = henries, C = farads.

Production of Oscillations by Means of Vacuum Tubes

In any method of high frequency heating, it is desirable to have an apparatus which is efficient, has a large range of frequency, and is readily controlled. For these reasons, vacuum tube oscillators are of great interest.

A simple illustration of unidirectional conduction in a vacuum tube might be helpful (Fig. 4).

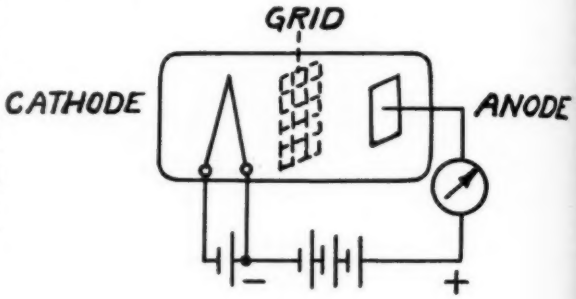


Fig. 4

The hot cathode emits electrons and these, being negatively charged, are attracted to a positive element and are repelled by a negative element. Therefore, current will flow in the anode to cathode circuit when the anode is positive and no current will flow when it is negative. The magnitude of the current will depend upon the electrostatic field at the cathode caused by the positive voltage on the anode. Sensitive control of this field may be obtained by the interposition of a control element or grid, between the anode and cathode. Variation of the grid voltage causes a corresponding variation of the anode current. Since this variation is uniform and continuous, we have the following characteristic from which it may be seen that as the negative grid voltage decreases, the anode current increases (Fig. 5). Now, considering the oscillation circuit (Fig. 6), the moment the high voltage is applied to the tube a voltage is set up across the circuit, L—C, due to the shock of charging the condenser, C.

This circuit is excited at its natural period and the instantaneous voltage relations will be as indicated by the dotted line, considering the axis of the coil as zero voltage. They will be just reversed at the next half of the cycle at which time the grid becomes positive and allows a surge of anode current to flow which contributes to the circuit, L—C, and maintains the oscillations at a fixed amplitude. The greater the amount of energy required by the

circuit, the greater the amount of power given to the circuit by the tube. Thus the vacuum tube acts as a control device, to regulate, uniformly and continually, the power of a direct current supply in accordance with the needs of the oscillatory circuit. Since the tube is controlled by the circuit, it is in exact synchronism at all times. Thus we have a very useful tool for generating a continuous train of undamped waves of almost any desired wavelength.

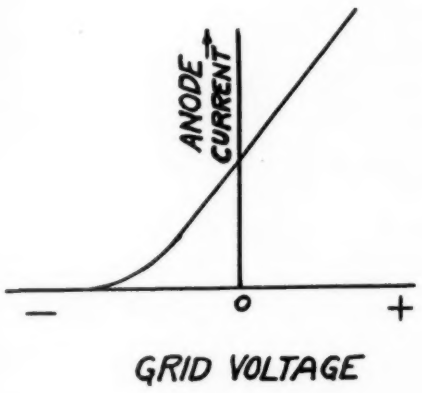


Fig. 5

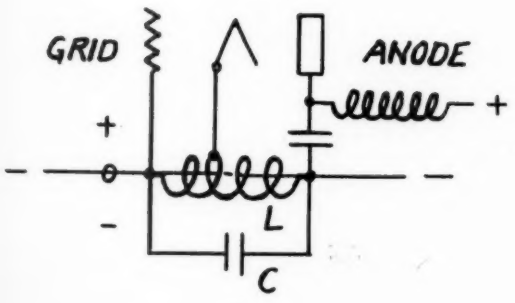


Fig. 6

Description of the Apparatus Employed

Having this useful device, which readily answered all requirements, the next step was to adapt it to the production of artificial fever. This was done first as a laboratory experiment and later as a more flexible design. The present apparatus, probably by no means the final form since new improvements are constantly being made to keep pace with the rapid development, employs a cabinet about three feet wide, three feet high and five feet long which contains all the apparatus for converting the low voltage, low frequency power supply to high voltage direct current by means of rectifier tubes and suitable transformers, and then by means of vacuum tubes and associated circuits to high voltage, high frequency energy. This high voltage, high frequency energy is then concentrated by means of two aluminum condenser plates to a limited field that may be utilized. These plates are usually on top of the cabinet and so placed that the patient or object to be treated may be placed between them and allowed to rest on the cabinet top. Having this general picture in mind, let us now consider the circuit in more detail.

The low voltage, low frequency energy (usually 110-120 volt, 25 or 60 cycle) is first fed into a controlling transformer which regulates the voltage input to the power transformer. The power transformer has a ratio of about sixty to one, so that 100 volts impressed on its primary produces 6000 volts from the secondary. This high potential alternating voltage is then applied to two hot cathode, mercury vapor, rectifier tubes (Type PJ-26). These tubes have the property of allowing current to flow only in one direction, that is, only when the anode is positive. Therefore, one tube at a time passes current and the high voltage alternating current becomes a unidirectional high voltage pulsating current. The rectifier circuit is a full wave circuit in which one tube passes current during one-half of the cycle and the second tube passes current, in the same direction, during the other half of the cycle (Fig. 7). The choke coil and filter circuit prevents surges of current and the pulses are therefore smoothed out and become practically a steady value.

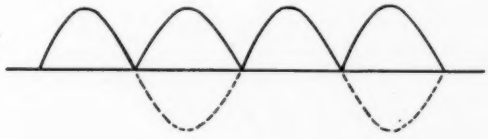


Fig. 7

This d-c. voltage is applied to the oscillator tubes (Type PR-861 or Type FP-2) and oscillations are generated of a frequency of ten million cycles per second. The oscillation circuit for this apparatus is constructed to obtain twice the voltage output across the heater plates. Two tubes are required to do this and they may be said to be in series, each acting to produce one-half of the voltage. The oscillations produced are concentrated by the condenser plates since the energy must all pass between them. The accompanying apparatus for the treatment of the human body employs a suspension produced by cotton tapes

stretched across a wooden framework. A celotex framework is used to cover the body and conserve the heat. (See Figs. 8, 9, 10.)

Some Aspects of Heating by Means of a High Frequency Electrostatic Field

The mechanism of the actual heating is not entirely known, but it is fairly definite that the heating is due to two causes; power loss in the body due to its resistance to the current passing through it, and the power loss due to what may be termed dielectric hysteresis. The major part of this heating is probably due to the former. To explain these losses, let us consider the simple rubber band analogy. First, I may take the rubber band and pull it between my fingers, allowing it to slip and produce heating due to surface friction. This might be compared to the loss caused by a current flowing through a resistance. Again, I can hold the two ends of the band and stretch it backward and forward and produce heating due to molecular friction inside the band. This heating is a function of the frequency, or rate of stretching, and is analogous to dielectric loss.

Fig. 8

The phenomenon of "selective heating" might be mentioned here. Selective heating is used as a term to describe the different temperatures that occur in various parts of a body due to a difference in the structure of the body. The high frequency energy does not particularly choose certain parts to be more greatly heated than others, but rather the parts having the most losses will be heated more, by nature of their concentration. To illustrate, a small polliwog may be washed and placed in a beaker of distilled water and the animal will be heated while the water will not. Or, for instance, holes may be bored in a piece of dry wood and if these holes are filled with some material, such as clay, it will heat while the board will not.

Fig. 9

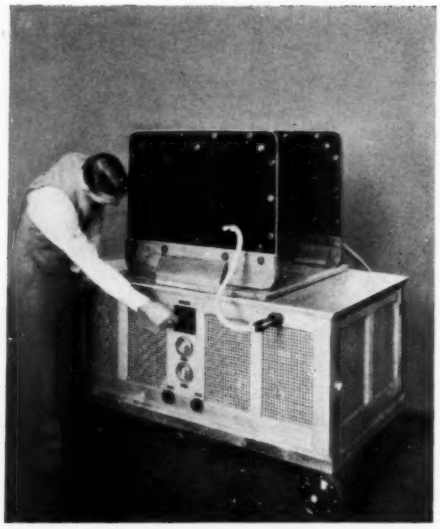
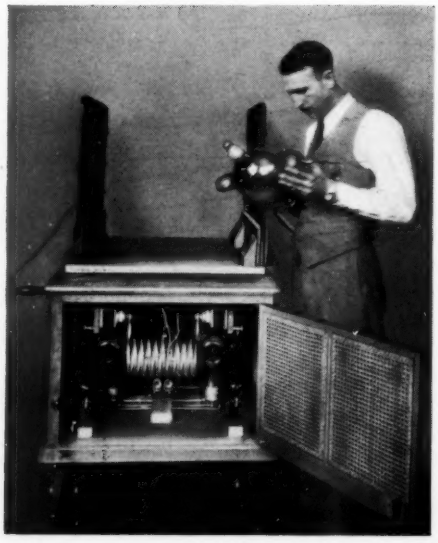


Fig. 10



It might be mentioned that, although we do not know all that goes on when a body is heated, we know that the process follows well-known laws and that electrically there is nothing at all mysterious in the heating or in the apparatus used in its production.

(Feb. 3, 1931.)

THE EFFECT OF HEAT PRODUCED BY AN ULTRA-HIGH FREQUENCY OSCILLATOR ON EXPERIMENTAL SYPHILIS IN RABBITS *

C. M. CARPENTER, Ph.D.

SCHENECTADY, N. Y.

When Wagner von Jauregg [1] first attempted to induce fever by experiments of injecting cultures and vaccines he met with failure. He persisted however in his studies, but, although he was able to obtain satisfactory results, he could not always keep the action under consistent control. Later on he attempted injection of foreign protein material and secured a certain amount of constant reaction. About 1917, he first began his work of developing malaria treatment for paresis. He injected, approximately, nine persons and observed very satisfactory reactions, but repetition of the experiment on other groups proved that the action was inconstant. In 1919, he was fortunate in obtaining a pure strain of malaria with which he succeeded in producing the results that are already historical. The method has since then been employed in America as well as in Europe. We know, of course, that the use of *Plasmodium malaria* often fails because the biologic methods employed are time consuming, difficult of application, not readily controlled and, to a certain degree, dangerous.

Other methods have also been employed to provoke a rise in temperature, such as hydrotherapy and general diathermy. I mention this merely as a background to the work done by us at the General Electric Company with ultra-high frequency oscillating currents to raise the temperature of the body. I have designated this type of current as the "Radiotherm" to distinguish it from general diathermy because it has many physical characteristics that separates it from ordinary diathermy. Radiothermy is an ultra-high frequency oscillating current and differs considerably from the circuits utilized in diathermy.

Hot water baths have been used successfully by Shamberg and Tseng [2] and by Mehrtens and Pouppirt [4]. Exposure of the body to artificially heated, dry and moist atmospheres has frequently been used in an attempt to raise the body temperature. Recently, diathermic methods for producing artificial fevers have been developed. Work of this nature has been done by Drs. King and Cocke,[4] of Tennessee, in one of the insane institutions in that state. No method thus far utilized has been found altogether acceptable or free from undesirable effects. In general, the malaria treatment has shown about 30 to 40 per cent favorable results.

Naturally, there are many questions as to how protein fevers, and especially the action of the *Plasmodium malariae* arrest the activity of *Treponema pallidum* and the progressive lesions produced by it. Does the value of such treatment depend upon the production by the malaria parasite of some anti-body that has an unfavorable action on the spirochete? or is some toxic substance elaborated by the infectious agent or by the tissues of the body during the course of malaria fever that destroys the spirochete? Is the benefit derived from a renewed general response of the cells to protect the body when the invasion by a second virus occurs, or does the increased heat in the tissues make an unfavorable environment for the *Treponema pallidum?*

The heating factor is what we are particularly interested in, for it is the relation of fever to disease with which we are primarily concerned. By the use of heat we can produce a fever without the introduction of foreign substances; and one of the great advantages of this method is that we can control the fever, or I might say, that we can control it better than when dealing with a foreign protein,—a substance of unknown potentiality which must be injected into the animal or human without any existing information of how to check its deleterious action.

I might mention here that in the research laboratories of the General Electric Company, Dr. W. R. Whitney, director, was the first to observe that there was an elevation of the body temperature in men working in the field of a short wave radio transmitter. Since then, considerable experiments have been undertaken to adapt this energy for producing arti-

* Read by invitation at the New York Physical Therapy Society, October 3, 1930.

ficial fevers. I think it remarkable that Dr. Whitney, as an engineer, saw the possibilities of temperature therapy and that experiments were initiated immediately for producing artificial fevers.

In our studies it has of course been necessary to do experimental work with animals. We wanted to know what effect these waves would produce in man, how long we could expose the body and what temperature we could safely create.

The first work was started on mice and rats, and from that we began to study the effect on larger experimental animals, such as rabbits and dogs. I shall not mention the specific results obtained except that we have found it a fairly safe method if one did not overheat the animal body. It is necessary, however, to make frequent temperature readings. We were primarily interested in its effect in syphilis, and in the effect of these fevers on *Treponema pallidum* infection; and since rabbits are susceptible to this virus, it has made it a very suitable experimental animal with which to work.

The disease was first produced by Bertarelli,[5] in 1906, when he successfully infected rabbits with *Treponema pallidum*, recovered from lesions in man. In 1907, Parodi [6] demonstrated that an intratesticular injection of the organism is the most satisfactory method of inoculating the rabbit. In 1930, Brown and Pearce [7], of the Rockefeller Institute, gave a complete description of experimental syphilis in rabbits, and showed that the disease could be readily developed. They succeeded in developing lesions in practically all of the various parts of the body where the disease commonly locates in man.

In our experiments we have worked with two strains of *Treponema pallidum:* the Nichols strain and the Zinsser-Hopkins. The former was first isolated from the spinal fluid in 1912, while the latter was recovered from a mucous patch in 1913. We obtained two rabbits, one infected with the Nichols strain, and the other infected with the Zinsser-Hopkins. We infected forty-five other rabbits with the testicular extracts containing *Treponema pallidum* from the two rabbits which we received. We have not done any culture work but have merely worked with the tissue extracts. It is better to use an adult rabbit than a young one for experimental work since the testes do not mature very rapidly in the latter. The rabbits were divided into three groups. In this experiment we worked with a wave 30 meters long. We have worked with waves of other meter lengths, but the thirty meter is a fairly short wave length and oscillates at the rate of 10,000,000 cycles per second. This particular wave is approximately the same as that used for broadcasting and for television.

Within three weeks after the injection of the infected testicular extract, the testes in the control animals began to swell up. Inflammatory changes began to appear, such as marked

TABLE I

INFECTED CONTROLS

Rabbit No.	Strain	Gain or Loss in Weight	Result
245	Nichols		Died peritonitis 3 days after injection
246	"		Typical lesions of experimental syphilis
247	"		Died peritonitis 3 days after injection
249	"		Typical lesions of experimental syphilis
251	"		" " " " "
371	"	+180 gm.	" " " " "
372	"	+130	" " " " "
373	"	+300	" " " " "
374	"	+100	" " " " "
375	"	—100	" " " " "
386	"	+430	" " " " "
387	"	+330	" " " " "
388	"	+420	" " " " "
389	"	+760	" " " " "
390	"	+390	" " " " "
449	Zinsser-Hopkins	+220	" " " " "
450	"	+360	" " " " "
451	"	+320	" " " " "
452	Nichols	+ 70	" " " " "
453	"	+220	" " " " "

edema and induration. Within six weeks a chancre was observed to develop at the site of the point of inoculation. I have frequently observed that the chancre would slough off and leave the scrotum exposed. This would result in infection, and is typical of what we observed in twenty controls. Only eighteen survived. Two died from peritonitis. The other eighteen developed typical chancres,

The apparatus built for this work will, as already indicated, send out waves of short radio frequencies. The waves are oscillating between the two plates and the resistance of the rabbits to these oscillations raises the temperature of the body.

The protocol of Rabbit 250 is here submitted as an example in order to illustrate the conditions under which the rabbits were

TABLE II

TREATED RABBITS

Rabbit No.	Strain	Gain or Loss in Weight	Result
244	Nichols		Edema and induration of tests.
248	"		Small nodule in one testis. Now normal
250	"		Normal
252	"		Normal
253	"		Normal
376	"	— 50 gm.	Died overheating, 7 days after injection
377	"	+ 90	Rectal fistula from thermometer. Died 31 days after injection. No syphilitic lesions or spirochetes.
378	"	+660	Died from hemorrhage after ear bleeding. Normal
379	"	+760	Normal
380	"	+470	Normal
381	"	+140	Nodules in testes. Now normal
382	"	+910	Nodules in testes. Now normal
383	"	—490	Died 41 days after injection. Purulent peritonitis. Impossible to examine for spirochetes
384	"	+120	Nodules in testes. Now normal
385	"	—520	Emaciated, coccidiosis, moribund. Killed 47 days after injection. No syphilitic infection demostrated
439	Zinsser-Hopkins	+350	Developed chancre that healed after intensive treatment
440	"	+360	Normal
441	"	+440	Normal
442	"	+620	Normal
443	"	+310	Normal
444	Nichols	+280	Nodules in testes. Now normal
445	"	+280	Normal
446	"	+420	Normal
447	"	+380	Normal
448	"	+270	Normal
432	Not injected	+380	Normal
464	0.1 c.c. horse serum injected	+270	Normal

which may be considered approximately one hundred per cent perfection.

The next group of rabbits treated by exposure to the short waves were placed in a glass container in order to overcome the skin burns that were wont to occur with great frequency. We could have protected the plate, but we found a battery to be equally effective. A platform in the jar was built in to protect the animal from burns that resulted when it was in contact with its own excreta.

heated, and shows the variation in temperatures before and after treatment as well as amperage, time and date.

We began our observations in the summer when the room temperature was fairly high. We observed that the humidity had a great deal of influence on the rapidity with which the animal heated up. We heated these rabbits every other day for seven weeks. They were given approximately twenty heatings. The rectal temperature was raised from three

PROCTOCOL OF RABBIT NO. 250

Date	Room Temp. Deg. Far.	Relative Humidity	Time Min.	Voltage	Amp.	Temp. Before	Temp. After
July 22			20	1700	0.15	103.8	105.8
24			20	1700	0.15	104.4	106.0
26	81	49	20	1700	0.15	103.6	105.0
29	88	40	20	1700	0.15	104.0	107.4
31	85	60	30	2000	0.20	103.1	107.2
Aug. 5	76	74	30	2000	0.20	103.0	106.8
7	78	75	30	2000	0.20	102.8	105.3
9	80	83	30	2000	0.20	102.8	105.0
12	84	80	30	2250	0.25	102.0	106.0
14	79	87	30	2100	0.30	102.3	106.0
16	71	66	30	2100	0.30	101.8	105.6
28	72	69	30	2200	0.25	102.4	105.3
30	70	55	30	2200	0.25	102.6	105.6
Sept. 3	92	45	30	2100	0.25	103.2	107.0
5	80	64	20	2100	0.25	104.2	107.6
7	80	72	20	2100	0.25	102.2	105.4
12	69	75	30	2100	0.25	103.8	105.1
14	71	90	30	2100	0.25	102.4	106.6
16	77	48	30	2100	0.25	103.6	106.0
18	65	56	30	2100	0.25	103.1	106.0

degrees to five degrees F., which required about thirty minutes when the plates were twelve inches apart. A voltage of 2100 was supplying a plate current of 0.35 ampere. The average temperature was 107 degrees F. The temperature of the rabbit returned to normal in approximately thirty minutes, which was about the same length of time the animal was treated. In winter we observed that we had to heat some of the rabbits longer to get the same results. We did not have a room with a constant temperature. In winter, rabbits cool off more rapidly than in summer. In winter it sometimes took thirty to forty minutes, and sometimes an hour, to heat the rabbits, depending altogether upon the rabbits' temperature.

In the beginning of these experiments we had not considered the value of the Wassermann test, hence it was not included as part of our routine observations. However, after we observed that the heatings with the short radio waves appeared to prevent the syphilitic lesions from developing, we became interested in finding out what such tests would reveal. The following chart shows the results of the Wassermann tests (infected controls). This gives the number of days (130 to 15) after inoculation. Tests made on infected samples of blood collected at various times gave four-plus reactions in all of the control groups tested.

TABLE III

WASSERMANN AND KAHN TESTS ON SERUMS FROM INFECTED CONTROLS

Rabbit	Strain	Days Bet. Inoc. and Tests	Cholest. Antigen	Acet. Insol. Antigen	Kahn Precip. Test
246	N	130	++++	++++	++++
251	N	138	++++	++++	++++
371	N	78	++++	++++	++++
372	N	78	++++	++++	++++
373	N	78	++++	++++	++++
374	N	63	++++	++++	++++
386	N	78	++++	++++	++++
387	N	78	++++	++++	++++
388	N	63	++++	++++	++++
389	N	76	++++	++++	++++
390	N	76	++++	++++	++++
449	Z	15	————	————	————
450	Z	23	————	————	————
451	Z	23	++	———	++
452	N	23	++++	+++	++++
453	N	15	————	————	++

It will be noted that there is a marked difference between the Wassermann's on the blood serums from the treated and untreated groups of rabbits, (Table IV). We were not certain that the rabbits had negative Wassermann's before injecting them with the spiro-

chetes. Since starting this experiment we have found that only sixty-three per cent of our stock rabbits were negative, twenty-seven per cent were positive, and ten per cent might be classed as suspicious to the Wassermann and Kahn tests. However, we have since determined that rabbits whose serums do not show complement-fixing bodies for syphilis develop in every case four-plus reactions from two to three weeks after injection. Some of the treated rabbits whose blood serums remained negative for three and four months have shown suspicious or positive Wassermann's later, while some of the other treated rabbits with positive Wassermann's became negative in a similar length of time.

up in about three weeks after it developed by increasing the duration and number of heatings.

A very important part of this work has been a study of the temperature throughout the body of the rabbit. As you know, the heat is produced within and by the tissues of the body. An examination of the various tissues of rabbits, sacrificed by overheating and autopsied immediately, showed that there was some variation when clinical thermometers were thrust into such organs as the liver, kidney, heart, etc. It was found that the temperatures of the liver, the heart muscle and the kidney were usually two or three degrees F. higher than the rectal temperature. The

TABLE IV

WASSERMANN AND KAHN TESTS ON SERUMS FROM TREATED RABBITS

Rabbit	Strain	Days Bet. Inoc. and Tests	Cholest. Antigen	Acet. Insol. Antigen	Kahn Precip. Test
244	N	128	++++	++++	++++
248	N	130	++	+++	+++
250	N	138	— — — —	— — — —	— — — —
252	N	138	— — — —	— — — —	— — — —
253	N	138	— — — —	— — — —	++
378	N	66	— — — —	— — — —	— — — —
379	N	75	— — — —	— — — —	— — — —
380	N	66	— — — —	— — — —	— — — —
381	N	66	— — — —	— — — —	+++
382	N	66	— — — —	— — — —	++
384	N	75	++	+	++++
394	N	68	— — — —	— — — —	Insuf.
434	N	36	+++	— — — —	++
439	Z	23	— — — —	— — — —	— — — —
440	Z	23	+++	— — — —	++++
441	Z	15	+++	— — — —	++++
442	Z	23	— — — —	— — — —	— — — —
443	Z	23	+	— — — —	+++
444	N	15	+	— — — —	++
445	N	23	+++	— — — —	++++
446	N	23	++++	++++	++++
447	N	23	— — — —	— — — —	— — — —
448	N	23	+++	— — — —	+++
432	Normal	60	— — — —	— — — —	— — — —
464	Horse Serum	23	— — — —	— — — —	— — — —

Comment

In general, the following results were obtained from twenty-five treated rabbits. Twenty-one showed no lesions (no chancres). Five of this group developed nodules in their testes, the size of a pea, during the treatments; but by lengthening or intensifying the exposures the lesions disappeared. One of the rabbits succumbed from overheating, and one rabbit died from an intercurrent infection. One developed a definite chancre, while the testes of a second became enlarged, edematous and indurated. We were able to clear this

liver, however, always showed the highest temperature by one or two degrees F., and paralleled the normal body temperature.

These findings made it seem worth while to determine the temperature of the various tissues of the body during life. We were particularly interested in the temperature of the testes of the normal rabbit as well as that of an infected rabbit after it had been treated. By using a thermocouple, in which a 22 gauge, 2½ inch hypodermic needle was used as a housing for the thermojunction, the needle could easily be applied to the skin, inserted

into the tissues beneath the skin, or thrust deeply into the vital organs of the body without causing great damage to the tissues or any great amount of pain to the rabbits. It was found that the skin of the scrotum of normal rabbits was from three to four degrees F. lower than the rectal temperature, while that of the testes was lower by one or two degrees F. Approximately these same differences were maintained in the heated rabbits. The temperature of the liver was found to be higher than the rectal temperature, while that obtained by inserting the needle of the thermocouple into the heart muscle was approximately the same as the rectal temperature.

TABLE V

Before Heating		After Heating	
Rectal Temp.	102.2° F.	Rectal Temp.	109.4° F.
Skin Scrotum	99.8° F.	Skin Scrotum	107.5° F.
Left Testis	101.3° F.	Left Testis	107.5° F.
Right Testis	101.0° F.	Right Testis	107.5° F.
		Heart	109.3° F.
		Liver	111.8° F.

These findings may explain why higher temperatures and longer periods of treatment were necessary in some instances to prevent the infection from developing and progressing in the testes. We believe the chief reason that the most extensive lesions of the disease remain localized in the testes of the rabbit is that the temperature in these tissues is lower than the temperature of the other tissues of the body and that a constant temperature of from 102 to 103 degrees F. is quite unfavorable for the multiplication of *Treponema pallidum*. It was often observed, especially in the younger rabbits, that the testes were withdrawn into the abdominal cavity whereas after heating they were well down in the scrotum, and because of their comparatively small mass, cooled off more quickly than the rest of the body.

Another interesting point in connection with these experiments has been the fertility of these males. Quite a few persons have been afraid to come near the machine because of the possible sterilizing effects of these rays. There need be no fear as to this. These rabbits were bred with other rabbits which were fertile and we had good litters. Our one great difficulty has been our unfamiliarity with animal breeding. This difficulty has been overcome by employing a trained attendant.

We have also become interested in the thermo death point—the point at which the spirochetes in tissues become non-infecting. We have carried on observations of this nature by making extracts from chancres, placing this extract in a little Sternberg bulb and making examination at hourly intervals. One of the little bulbs is removed and the contents injected into a normal rabbit to see if it is still infectious. We are just in the beginning of this work, and the results have been somewhat inconsistent. Temperatures of 105 to 106 degrees F. have a detrimental effect on the fertility of the spirochete. We merely place the little bulbs in an incubator and keep them for six hours. We experimented at different temperatures and for different lengths of time. At 103 degrees F. there arose a peculiar situation which we still do not understand. We did not obtain any lesions with this temperature. At 104 degrees F., for two or three hours, we obtained definite chancres. At 104 degrees F. for four hours, no marked changes followed. At 106 degrees F. for one hour, infectious growths were stimulated; at the same temperature for two hours the results were absolutely negative. These experiments are to be repeated again.

Another interesting aspect of our work has been the study of the influence of high frequency oscillating currents on metabolic processes and the blood chemistry of these animals. This problem was carried out by Drs. Warren and Massett. The work was done on a series of dogs because of the easier facility to obtain the necessary quantity of blood. Straight diathermy rather than the radiotherm method was employed, but we are getting practically the same results with the radiotherm. They found that as the machine is turned off, the temperature continues to rise and the oxygen consumption is proportionately decreased. The animals were heated until death occurred. The plates were kept on until the animal expired. This was a very in-

teresting experiment, but there has not as yet been an explanation as to why there is a decrease in the oxygen consumption while the temperature continues to rise.

The results of blood chemistry in the dog is also interesting. We have only determined the sugar, CO_2 content and non-protein nitrogen. There is in the beginning an increase in sugar when the heat is turned on, i. e., a culling of the sugar. After the reserve has been culled out, as the temperature increases, the sugar decreases. In our particular study it was plus 17 at the start and dropped to 69 at the finish. There is a marked pumping out of the CO_2. Half of the CO_2 is pumped out of the blood. In the non-protein nitrogen (protein metabolism) there is a marked increase. This may be due in part to a dehydration process, for it rose to plus 87 per cent at the end of the experiment.

Studies were also conducted on the relation of body temperature to that of oxygen consumption. When the body was heated within physiologic limits the oxygen consumption fell below average limits. When the temperature was raised above this limit the oxygen consumption went up and the animal expired.

Conclusion

From these experiments, we can conclude that the heat produces in the body an unfavorable environment for the spirochete. Secondly, we think that there is thus produced an augmentation of all of the chemical processes, especially those which are concerned with the defense of the body.

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THE HEATING EFFECT OF SHORT RADIO WAVES *[1]

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Considerable interest has recently been aroused by the discovery that curious and unexpected physiological and biological effects are produced by electromagnetic waves of wavelength 50 meters and under. An effects are produced by electromagnetic waves and his co-workers in 1924 (1), whilst Schereschewsky (2) in 1926 noted their lethal effect on mice. Experiments in the General Electric Company's laboratories showed that fever was produced in men exposed to the radiation emitted by a short wave oscillator. Experiments by Wood and Loomis (3), Hosmer (4), Kahler, Chalkley and Voegtlin (5), and Christie and Loomis (6), have shown that all the phenomena observed so far can be explained as due to heating produced by the radiation, rather than to a direct action on bacteria or on living cells. Nevertheless, the unique character of these heating effects and the peculiarities of their production are finding wide application in curative medical science and the possibilities are as yet unknown. The reports of Carpenter and Page (7), among the many being given, already indicate considerable success in the production of artificial fevers by the use of short radio waves.

It was of importance, therefore, that the physical processes underlying the production of the heating should be investigated and at Toronto, as at other places, a research was undertaken to discover how the physical characteristics of the body being heated, as well as its position in the field and the characteristics of the radiation, determine the effects produced.

In this investigation I was fortunate in having Mr. A. C. Burton, one of my research students, as an associate and collaborator. Much of the success that we attained was due to his insight into the nature of the phenomena involved and to the discriminating sense

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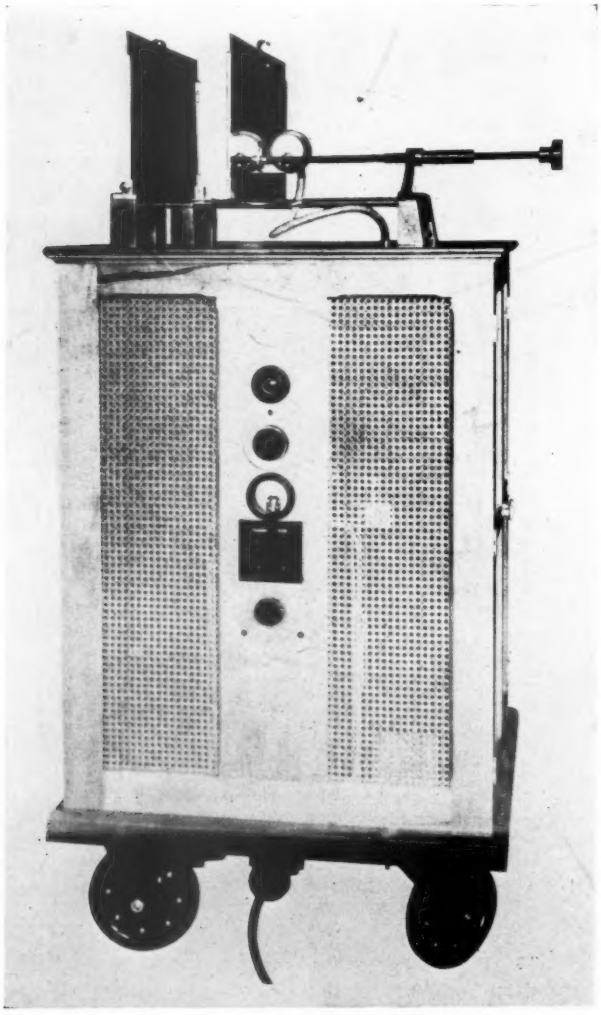

Fig. 1

he showed in his design of the requisite minor equipment and in the selection of the best conditions under which to use it.

Our starting point was to find how solutions of a simple electrolyte such as sodium chloride in various concentrations behaved in the field of the oscillator. This apparatus was a high frequency heater (figs. 1 and 2) giving an output of 1 kilowatt at a wave-length of 25 meters. It was the gift of the General Electric Companies of Schenectady and Toronto, arranged through the kindness of Dr. Whitney. The solutions were placed in a small vessel in the center of the field between the large plates of the machine, and their rise in temperature measured when irradiated for a short time. The vessel was vacuum-jacketed to reduce loss of heat, and temperatures were recorded in the first experiments by the expansion of the liquid itself, later by a thermocouple with potentiometer giving quick and accurate readings to 0.2°C. In order that the results might be interpretable in terms of the least number of variables, it was arranged for the heated liquid to be small enough in amount to ensure that, when the range of solutions used was introduced into the field, there was no appreciable change in the output of the oscillator. That is, we approximated in our experimental conditions to the ideal case of a "leaky" dielectric mass introduced into a constant "external" field.

It was found that with increasing concentration, the heating effect increased rapidly from that of pure water to a maximum value (at a concentration of 0.0045 N for NaCl), after which it decreased in an exponential-like curve till at four times normal concen-

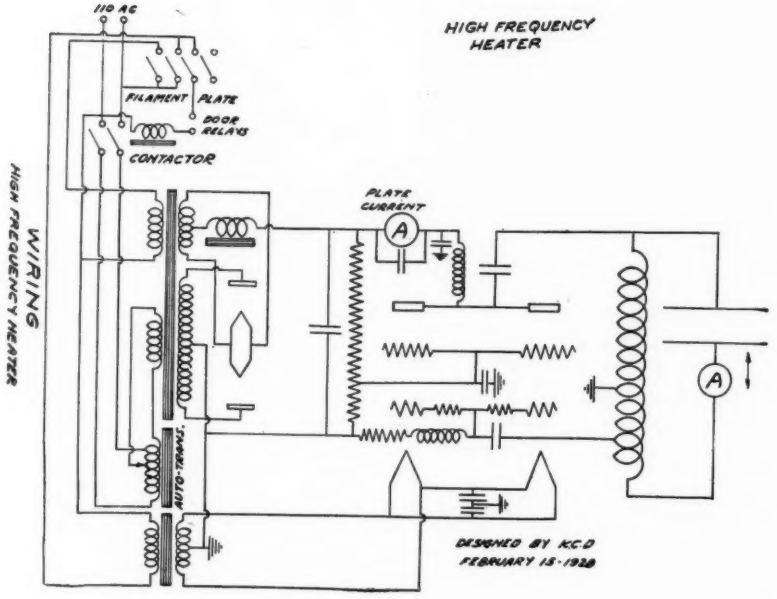

Fig. 2

tration the heating was little more than that of pure water (fig. 3). The use of differently shaped vessels of different sizes to contain the solutions, gave widely different amounts of heating, but always the same shape of curve with the maximum at the same concentration (fig. 4). Experiments with other salts, HCl, LiCl, KCl gave curves similar in shape but with maxima at quite different concentrations (0.00125 N for HCl). The maximum, however, is not the result of any "resonance" phenomenon dependent on the constitution of the substance heated; but is found to be dependent on the electrical conductivity of the solutions. Thus if in figure 3, the electrical conductivities of the particular salts were plotted as abscissae instead of the concentrations, one curve would represent the behavior of all of them. As Richards and Loomis (8), Hosmer (4), and others have found, the heating is the same whatever the nature of the solution used, provided the elec-

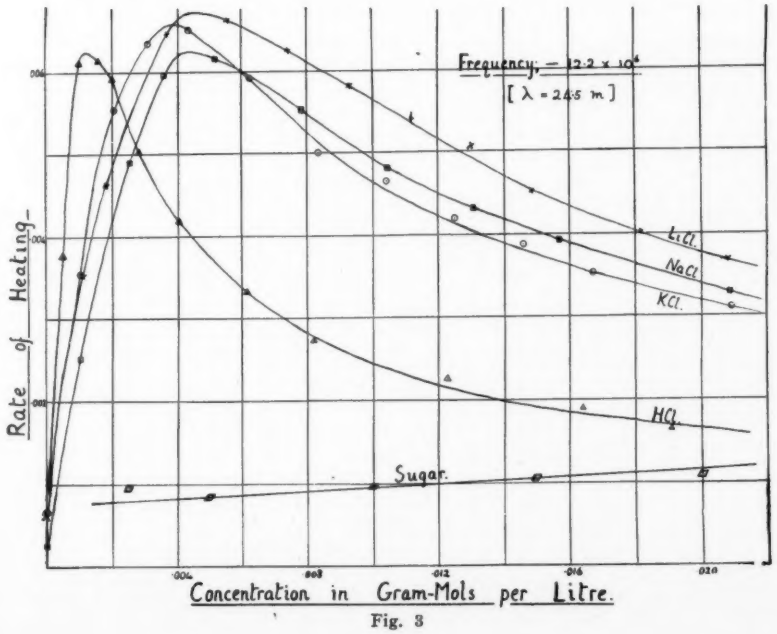

Fig. 3

trical conductivity is the same. This is true even for colloidal solutions. It is to be understood, however, that the dielectric constants of all the solutions must be approximately equal.

As has been mentioned, the shape, size and position of the medium heated has a very marked effect on the amount of the rise in temperature, although the curves obtained with varying concentrations are similar. For instance, when an elongated body—say "sausage-shaped"—is placed with its long axis parallel to the electric field, i. e., at right angles to the plane of the plates of the apparawhen it is perpendicular to the field. This tus, the heating is many times greater than probably explains some of the conflicting results of early investigators. The orientation of the specimen in the field is of great importance.

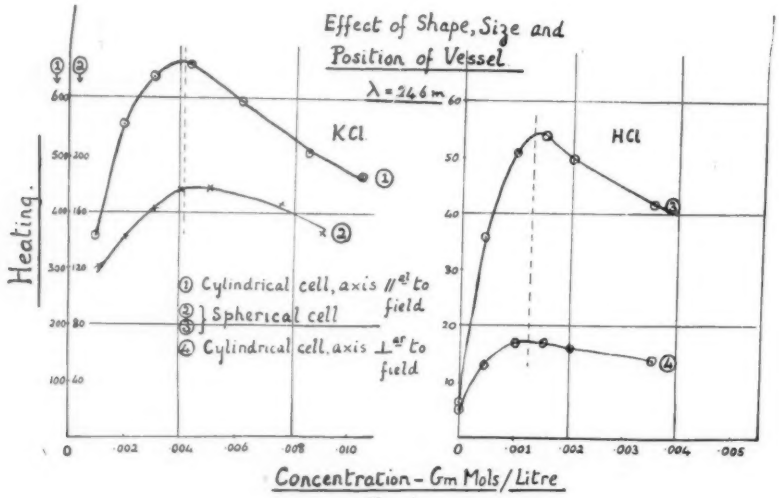
Effect of Shape, Size and Position of Vessel
λ = 24.6 m
KCl
HCl
Heating.
① Cylindrical cell, axis // to field
②③ Spherical cell
④ Cylindrical cell, axis ⊥ to field
Concentration - Gm Mols/Litre

Fig. 4

The effect on the phenomena of changing the wavelength of the radiation was next examined. An oscillator was constructed by which with interchange of coils, wavelengths from 8 meters to 200 meters could be obtained. It was found that with a higher frequency (shorter wavelength) the maximum effect was produced in a solution of higher conductivity (fig. 5). Indeed, the relation between the frequency and the conductivity which is most heated is the very simple one shown by the graph (fig. 6). The conductivity, it will be seen, is directly proportional to the frequency. It follows, then, that the curious selective action of the radiation is controllable by choice of wavelength. At 200 meters the optimum conductivity is about $0.75 \times 10^{-4}\ \omega^{-1}$ cm.$^{-1}$, whilst at 10 meters it is about $15 \times 10^{-4}\ \omega^{-1}$ cm.$^{-1}$.

The results can be explained by a simple

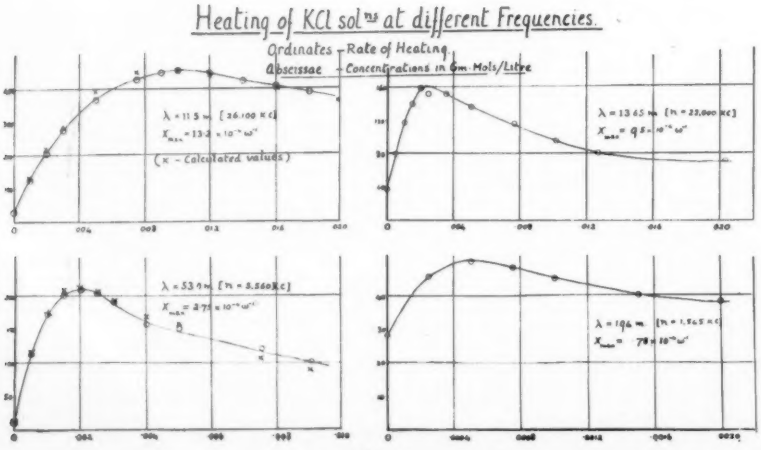
Heating of KCl sol^ns at different Frequencies.
Ordinates - Rate of Heating.
Abscissae - Concentrations in Gm. Mols/Litre
(x - Calculated values)

Fig. 5

theory. The problem is this. We have a piece of a dielectric substance of a given specific inductive capacity (that of water and of the solutions is about 80 for the frequencies used), which conducts slightly, and has a given electrical conductivity. This material is placed in a "uniform" (in the sense that it was uniform before the specimen was introduced) electromagnetic field of given intensity and frequency of alternation. The field can be treated simply as an alternating "electrostatic" one, the effects of the accompanying magnetic field being neglected. The so-called "skin-effect" which confines high frequency currents to the surface of conductors and has been generally considered to operate in high frequency electrotherapy, is in reality of no importance in these experiments. It can be shown from the theory of the "skin-effect" that it is only in good conductors that it is large; and for such conductivities as we encounter here, and in the human body, it is negligible. Our experiments with different vessels as well as those of Pariseau (9) demonstrate the validity of this statement. The heat is produced throughout and in the interior of the specimen. It is this feature that makes the short wave method of thermal treatment unique and powerful.

The dielectric constant plays the important part in determining what the field induced inside the specimen will be. How this depends on the shape of the specimen and its orientation in the field is a problem in electrostatics long ago solved for certain cases—as for the ellipsoid. When the dielectric constant (water, 80) is greatly different from that of the surrounding medium (air, 1) the field varies enormously with the orientation of the long axis of the specimen. For a very elongated "sausage" when it is at right angles to the external field the electrical intensity inside it is only 1/80th of what it is when parallel to the field. This point has been prominently illustrated in our experimental results.

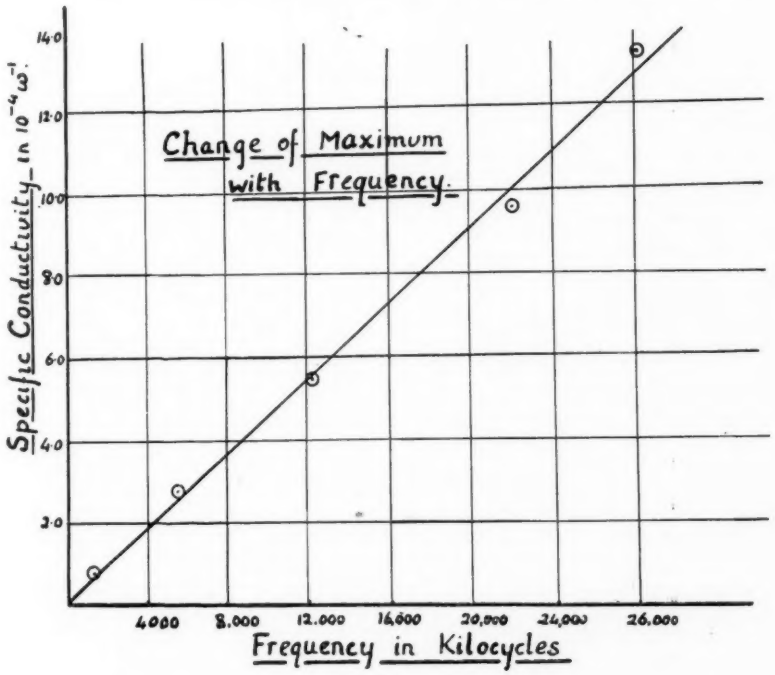

Fig. 6

The induced field inside the specimen produces electrical currents, and here the conductivity plays its part. We have two currents—the "displacement current" of Maxwell due to the charging up and discharging of the capacity provided by the medium, and the "convection current" due to the ordinary conductivity. It is the combination of these two currents, with the phase relationship between them, that gives rise to the curve observed for the power loss, or heating, with its maximum for a certain conductivity. The equation for heating is of the form

$$P = (\text{Constant}) \times \frac{C}{1 + \left(\frac{2C}{Kn}\right)^2}$$

where C is the conductivity in absolute units, K the dielectric constant, and n the frequency of the oscillations. Simple calculus shows that such an equation gives a maximum at a conductivity given by

$$\frac{2C}{Kn} = 1 \text{ or } C_{\max} = \left(\frac{K}{2}\right) \times n$$

i. e., the conductivity for a maximum heating is proportional to the frequency — the law found experimentally. When applied, moreover, to the experimental results, the law gives for the dielectric constant of water and of the solutions $K = 81.7$, which is in agreement with recent results for these frequencies. The theoretical curves fit the experimental ones closely.

It is important to realize that the maximum is with respect to conductivity, not to frequency. If we have—and this is the practical case met with in electrotherapy—a heterogeneous mass of varying conductivity (the dielectric constant being supposed the same throughout) and place it in a field of a given frequency; there will be a portion having a conductivity, given by the law indicated above, that will be heated more than parts having any other conductivity, i. e., there is a "selective" heating. But if we take one substance only into consideration and heat it by varying frequencies, there is no particular frequency that will produce a maximum effect; the heating increases steadily with frequency, the intensity of the field being kept constant. Typical curves are shown in figure 7. (These cannot be obtained directly by experiment as we have no means of knowing when the two high frequency fields of different frequency are equal in intensity with any certainty.) For a substance of different conductivity the curve is similar but has different parameters (curves 2 and 3). The conductivity is increasing from (1) to (3). Thus with frequency as at A, substance (1) heats more than either (2) or (3), at B substance (2) is best, and at C (3) heats most. That control of the selective action of the heating may be possible and usefully employed was demonstrated by an experiment on blood, which can be separated into three different constituents of different conductivity but approximately the same dielectric constant. Three preparations were heated; A was whole blood, B the same minus the corpuscles, C with, in addition, the electrolytes removed by dialysis, leaving just the proteins. Relative heatings at three different wavelengths were as below.

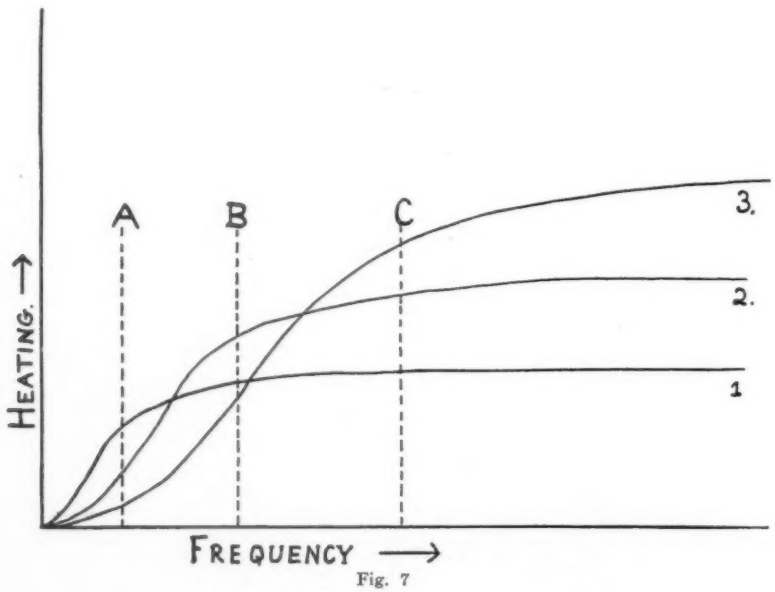

Fig. 7

Experimental Results

Solution	Heating Produced at Different Wavelengths		
	43 Meters	15 Meters	9 Meters
A	1.21	1.39	1.43
B	1.00	1.00	1.00
C	3.81	3.53	3.21

It will be seen that as the frequency is increased the relative heating of the corpuscles increases, while that of the protein decreases.

There is then the possibility of directing the selective heating by short radio waves in two ways. First, if the dielectric constants of different parts of the body are different, by proper orientation of the body the heating of one member may be favored. Secondly, by choice of wavelength the heating of portions having a certain conductivity may be favored.

Further research should be made in two directions. Exploration of temperatures produced in the various parts of animals by the oscillations (made possible by the perfection of thermocouple needles recently described in this *Journal* (10), will show if these differential effects are of importance, or if they are made negligible by heat exchanges, such as are promoted by the blood flow. At the same time, information as to the electrical properties of body materials, their conductivities and dielectric constants, will enable us to draw curves as in the last figure for all the constituents and to choose the wavelength most suited for our purpose.

In concluding this brief statement of the result of a very interesting investigation, I may be permitted to add that we were greatly aided in our research by financial support from the National Research Council of Canada.

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Discussion of DeWalt and Carpenter's Papers

DR. WILLIAM BIERMAN (New York): The relation of heat to human ailments is a subject which has probably not received the attention it deserves. Until a short while ago physicians have regarded fever as an injurious condition, as a condition which must be treated by means of antipyretics, hydrotherapy, etc. The concept that fever may be a defense mechanism used by the body in combating disease is a fascinating one. It is only in recent years that we have purposely begun to institute fever within the human body. To have listened therefore, to the pioneer workers in the field of electrically induced fever and to their experiences regarding methods of raising human temperatures by means of the radiotherm, an apparatus employing oscillating currents of very high frequency has been an interesting evening.

There is a great deal to be said about this method of treatment, a great many factors to be mentioned. I have been watching the progress of this work very closely, both Dr. Carpenter's studies at Albany and the work of the Psychiatric Institute. Personal observations have convinced me that the temperature and the pulse must be carefully watched during treatment. At the Beth Israel Hospital we use the platinum resistance thermometer to give us an automatic record, a record that we can see instantly. We are now working with a new device for automatic pulse recording, which permits us to see immediately what the pulse record is. Obviously, with new devices it is necessary to develop new technic. Any apparatus may prove dangerous if used carelessly. We must watch pulse, temperature and respiration.

Dr. DeWalt asked as to the effect of such radiations. Work has been done with high frequency oscillating currents by Schereschewsky on mouse and chicken sarcoma, reported in October, 1927, which was checked by Christie and Loomis of the Rockefeller Institute. There seems to have been no specific effect on tumors.

Our own experimental work is entirely in the preliminary stages. The work is too young for any authoritative statements to be issued except by Dr. Carpenter. I recall an interesting phenomena that occurred at a time when I was observing the heating effects on a rat. We were able to raise the temperature 8 degrees Centigrade within a period of ten minutes (to 43.3 degrees C.) before killing. We picked the animal up by its tail and the tail came off! The tail had coagulated and separated with the same ease as thought it was amputated.

There are many interesting things to consider about this new machine, as, for example, the temperature of the patient which continues to climb after the patient is removed from the influence of the machine. The limitation of time will not permit me to touch upon all of the interesting points raised by the essayists. We are greatly indebted to Drs. DeWalt, Carpenter, and Hinsie.

A point of great interest in this work is the desire of a large commercial corporation in this country to do something for mankind. I know in talking with Dr. Whitney and his associates that the motive behind these experiments is not a commercial

one. Later on it may prove of commercial value, but the commercial aspect is not the motivating objective. The idea has been followed up by Dr. Whitney because he thought this might be a contribution by the General Electric Company to humanity at large. The company has indulged in this particular medical problem because the work is very near and dear to Dr. Whitney, who has spent a great deal of time on it. We have enjoyed the unusual opportunity of listening tonight to the result of researches for which he is responsible.

Dr. Sam Parker (Bellevue Hospital, Psychopathic Department, New York): Aside from the practical questions involved, the use of radiothermy and the experimental work of Dr. Carpenter were of the utmost theoretical importance. The whole question of the active principle, the *modus operandi*, of the non-specific, febrile, heat treatment of nervous and other diseases was being reactivated rather than stilled. Both the lectures and the previous discussants implied tacitly that the heat itself, that is to say the fever in malaria treatment, was the principle which cured paresis, for example. Dr. Carpenter implied by his experiments on the heat resistance of spirochaetes that it was probably the death of the spirochaetes as well as an increased resistance of the tissues which formed the basis of paretic remissions or, in the case of his experiments, the curing of chancres in rabbits. He failed to mention, however, that Wagner-Jauregg still insist that it is not the fever which can be held responsible for the cure of paresis, especially since every clinician who has had extensive experience with malaria knows that patients may show excellent remissions after having gone through several weeks of malaria without temperatures over 100 to 101 degrees F. Dr. Carpenter's experiments show, as did the work of Jahnel, that heat applied externally will kill spirochaetes in the rabbit and lead to a transformation in the blood Wassermann reaction as well as stop the further growth of a chancre. The experiences with human paresis are, however, still too premature to use for comparison with the known facts first developed by Wagner-Jauregg.

Dr. Carpenter's interesting temperature measurements reveal the important difference in the reaction of spirochaetes in different environments. Whereas, he found that the *treponema* thrives well in the rabbit at an average normal body temperature of about 102 degrees F., we know that no spirochaetes have been found as yet in human bodies which have gone through temperatures no higher than this one; that paretic brains are usually a good source of active spirochaetes, but not after they have been treated with malaria which has not gone above 102 degrees F. or thereabouts.

A most important theoretical difference between the new radiothermy and non-specific febrile treatment is the fact that the former is a means of applying heat mechanically from without; the latter may be termed, from the biological point of view, a purely natural form of combustion. It is automatically regulated from within by means of biological mechanisms which, because of the parenteral nature of the application, result in a so-called immunological change in the status of the host. Whether or not the radiotherm will show any sort of biological influence on the organism in this sense is an important question yet to be settled. Also, whether under such circumstances one could say that the heat application itself were the sole active principle of the machine. The difference between a mechanical and a biological form of heat production is not only of theoretical, but also of considerable practical significance.

Dr. William H. Schmidt (Philadelphia): I would like to emphasize very much the importance of this new venture. The experience I have had has not been with this new apparatus, but with the high frequency machine. There is some difference in technic. With Diathermy, you must put the heat in the body and prevent its radiation, so that in treating patients by means of Diathermy it is necessary that they be wrapped in blankets in order to prevent loss of heat. I do not know much about the Radiotherm, but with diathermy, it takes about two hours' time to elevate the temperature to 105 or 106 degrees, going up slowly and gradually. The patients to be treated should be carefully selected, as this form of treatment is very strenuous and every patient can not stand it. If you take the general run of patients, without careful selection, you will get into trouble. The patient with a bad heart, or any other degenerative condition, is not suitable for this type of treatment. We had one death, which shows that the treatment is attended with some danger. One must be careful, therefore, in the selection of the patient; careful in technique, and not give the treatment too vigorously. It is also possible to burn the patient, so the electrodes must be properly placed and held firmly in position. All possible means of protection should be used.

The type of cases that I have worked on have been the ones usually seen in a general hospital, and we do not have a large number of cases of paresis. Such cases are usually picked up in the dispensary. However, I have treated a few cases of general paresis, with blood and spinal fluid showing a 4 plus Wassermann, and with marked nervous and mental symptoms. These patients were given nine treatments of diathermy, with the temperature elevated to 105 degrees. When the temperature reached 105 degrees we shut off the current. With the patient wrapped in blankets, the temperature usually remains up for about four hours. This patient received nine treatments and, as a result, in the course of a few weeks' time, showed marked improvement. The blood Wassermann became negative, and the spinal Wassermann became 2 plus. Another series of treatments were given which produced a negative Wassermann in the spinal fluid. We have treated a number of other cases, but the time is too short to say anything about results, but the case referred to did show a negative Wassermann; although it was necessary to give a second series of treatments before developing a negative spinal fluid.

We have studied a number of cases of multiple sclerosis. In a general hospital, we run across more of this type. One patient, 24 years of age, had numbness in both legs, was unable to walk, and had so much weakness in the arms that she was unable to lift them over her head. There was loss of vision in one eye and control difficulty with bladder and rectum. She was given a series of treatments. After the first series, she showed marked

improvement. The patient was very enthusiastic about the treatments; and although her condition did not entirely clear up, she was very much improved. She insisted upon having further treatments, and we gave her a second series. Now, after two months, she is walking around without assistance, and has control of bladder and rectum, and the sight in the affected eye has returned. Her general condition is markedly improved. Whether or not the improvement will continue, we cannot tell, but it has been progressive since the treatments. Other cases have shown similar improvement, and our work with multiple sclerosis has been very encouraging.

Another case was a patient with a varied medical history. She had had thyroid trouble, pernicious anemia, following which there developed nervous symptoms associated with sub-combined degeneration of the cord. At the time of treatment this patient was in a very similar condition to the one just mentioned. She was unable to walk because the legs were totally incapacitated, but had some use of arms. Following treatment, the patient has shown progressive improvement and can walk, with support, around the room.

We are also treating other cases as they come to us. We have in mind the possibility of treating multiple arthritis, particularly cases with no marked bone changes, lung abscess, chronic sinus disease, infections, etc. We will try some of these cases and see what the results will be.

There are many types of disease available for this form of treatment. Of course, we do not know if the improvement will be permanent or temporary, nor do we like to make any predictions, but the results have been so encouraging that we intend to go ahead and treat as many as we can, selecting such cases as may seem desirable, and those where we can hope to improve the patient's condition.

We are also attempting to carry out with the treatment as much clinical and laboratory work as we can. Of course, it is difficult in these cases to follow out the laboratory work, but we are doing what we can.

With these treatments, it is necessary to observe the temperature at frequent intervals. In the earlier cases, taking the temperature with an ordinary thermometer in the axilla was not a very satisfactory procedure: that was one of the drawbacks. Now we have an electrical resistance thermometer connected by a rubber-covered wire to a recording apparatus. This records the temperature every thirty seconds. It is possible to attach three thermometers to one recording drum. This tells the exact temperature at all times, and you always know what your patient is doing. We have made some interesting observations along this line. In one case we placed one thermometer in the axilla and one in the rectum. In the beginning, we found that there was a difference in the readings of one degree or more, but they gradually approached each other up to 103 degrees, where both were registering about the same, and continued the same from that point up.

I feel that there is a large field for investigation in this form of treatment. It is not going to be something that you can decide off-hand, because it will require time and study before we will know exactly what the results will be. So far as the apparatus is concerned, I feel that the high frequency apparatus, giving a high voltage, is better than those giving a low voltage. In machines giving the high voltage, the elevation in temperature takes place more quickly than with the low voltage.

I have had so short a time to work on those cases, and so little opportunity to get the data together and correlate it, that nothing I have said can be taken as final, but simply as an indication of what we may be able to do in the future, after a proper selection of cases has been made, and the technic properly refined.

DR. LEON T. LEWALD (New York): Has this method been used in cases of tumor? One sees a reaction after Coley's fluid—a marked reaction in temperature. One therefore wonders if this method would be of value in the treatment of sarcoma, or other forms of malignancies.

In a sunstroke season in New York, in 1896, I believe there were temperatures recorded as high as 118 degrees. A great many clinical thermometers were broken. Cases recovered with temperatures I am sure as high as 112 and 114 degrees. It has been recorded in Manson's Tropical Medicine that New York was the place where they had the highest temperatures ever reported in sunstroke. It is therefore possible for a person to recover with such a high temperature. In these sunstroke cases the skin is hot and dry and devoid of sweating. Usually high temperatures are generally associated with exceedingly dry skin, as mentioned by Dr. Snow.

DR. FRANK T. WOODBURY (New York): I feel that the evening's program has not only brought us further upon our progress in our fight upon therapeutic nihilism but it serves to bring forcibly to the attention of the medical profession in general the importance of electrothermotherapy which already has an honorable history of over thirty-seven years.

The physical laws of the circuits and currents employed are firmly established in scientific practice, and its apparatus are based upon those laws. The physiological effects of electrostatic and electromagnetic fields of high frequency and high potential are now well known to all practitioners of physical therapeutics, while the indications and contraindications, based upon over thirty years of accumulated clinical evidence, have grown to proportions which are coterminous with medical and surgical practice.

I do not need to remind the members of our sosiety of d'Arsonval's "Grande Solenoid" by which he first had the honor of presenting these physiological effects to the world; nor Apostoli's condenser couch, Nagelschmidt's double condenser technique which singularly resembles the technique with the apparatus presented to us tonight, DeKraft's condenser chair, the hand condensers of Strong, known as the vacuum glass electrodes and their non-vacuum variation, and the resonator treatments of DeKraft. The first therapeutic employment of an oscillating tube circuit was made by Grosset, Gutman, Lakhovsky and Magrou on plant tumors in 1924, using condenser electrodes. The next was by Schereschewsky and Andervont in 1926, using the same sort of circuit upon mouse and chicken sar-

coma. The Society will recall that the speaker had the honor of reviewing at greater length all these methods of electrothermotherapy at the October, 1927, meeting, and that Mr. Hallberg demonstrated at that time the construction and working of the oscillating tube circuit and the standing wave on the antenna.

The lack of interest in these very important thermo therapeutic procedures can be ascribed, I believe, to the obscurity arising from the use of queer names for different methods of technique, all of which produced physiological effects essentially and fundamentally the same, and could be simply denominated local or constitutional effects of heat, engendered from within. In brief, endogenous heat.

Whether we use the two fundamental arrangements, the condenser or the induction coil; whether our treatment energy is a high frequency electrostatic or a high frequency electromagnetic field; whether we start out with an electrostatic machine, an alternating current, or an oscillating current from an oscillating circuit or an oscillating tube, are matters of necessity or election, but the resultant energy which is the remedial agent is endogenous heat.

I may interpolate here that these are the gross effects. When minute currents are employed we may expect to see effects due to frequency and to wave form of the absorbed energy which may prove of specific therapeutic application.

Would that every undergraduate medical student were grounded thoroughly in the physiological effects of heat when systemically or locally engendered in the tissues and how to choose the indicated technic and then how to apply it correctly. Had this been done even fifteen years ago it would not have needed a von Jauregg to point out the therapeutic value of fever which Benvenuto Cellini experienced in his own person in the sixteenth century. Certainly the high reputation of the baths at Hot Springs, Arkansas, in the treatment of syphilis when combined with mercurials and iodides has not been forgotten. Our own members, individually and in committee reports, and many others here and abroad, have given ample testimony to the benefits of thermotherapy in various affections as gout, arthritis, septic fevers, inflammations, cardio-vascular hypertension and many others.

We are therefore much indebted to these gentlemen who have spoken to us tonight and to those who have perfected this apparatus, and to the General Electric Company which has not only made this work possible but has also recently given us another source of heat as well as chemical rays in their new Sunshine lamps.

We are doubly indebted for what they have given us and also because they have aroused the attention of the entire medical profession to the much neglected but highly valuable remedy—heat.

Dr. Charles M. Carpenter: We believe that the liver may heat up more rapidly than the heart. The liver always showed the highest temperature, but this also occurs when the body temperature is normal.

Concerning hysteresis. That is purely a theory. We have not sufficient information to say we have direct hysteresis. There is a small effect. I believe that this is the basis upon which the heating takes place.

The pulse rate and the rate of respiration is extremely interesting. I am sorry we have no charts to show this. To our great dismay the pulse rates have been too high to make us happy. At times the pulse rate has gone up to 180 and even to 200.

At present we are exposing the lower part of the body, from the hips down. We started by heating the trunk of the body, thinking that perhaps by taking the patient's heart out of the field we might get down the heart rate. This, however, is not true with all patients. We have treated patients whose heart rate might not go beyond 120. A high heart rate may, of course, be due to nervousness or irritability. We have found that exposing only the lower part of the body has had some effect in lowering the heart rate. The respiration is satisfactory. It does not increase as rapidly as the heart rate. It has been over thirty, but as a rule has behaved better.

No price has been made up on the machines. They have been constructed only for experimental purposes. It costs about four thousand dollars to construct one of these machines. This, of course, is a prohibitive price except from an experimental standpoint. It is an expensive plaything at present.

As to the effect on tumors. I hesitate to make a statement as to this. We have done some work with sarcoma in birds. The birds were heated. One-half saved for controls. We found that in the treated birds the high temperature had a favorable effect.

There has been a statement made that a man doing some work of this nature had been able to cure some rat sarcoma. I do not want to say that I do not believe it, but I feel as Dr. Hinsie does that we should not let our thinking be influenced by some statements such as that.

Dr. Harry E. Stewart (New Haven, Conn.): Most of the members will remember Dr. Wilmoth's report of the work carried out by King and his associates. This kind of work is now being done by the Massachusetts State Commission and is similarly successful.

We welcome this new type of apparatus but I think the matter of expense is one to be considered. After considerable experience in buying apparatus, I doubt if these machines are given away "with a pound of tea." What do they cost? I would be extremely interested to see what it would do in pneumonia cases.

Dr. William B. Snow (New York): Dr. Carpenter has shown us what temperature will do in the treatment of syphilis by heat. If the temperature results in bringing about a disappearance of the Wassermann high reading, this demonstrates a point which I think Dr. Schmidt has still further corroborated. It is apparently a matter of temperature and with that principle in mind I think we have to consider what apparatus will give the best results. As I understand it, with the radiotherm the patient must be treated nude in the path of the wave. The loss in heat by evaporation and a consequent interference with the degree of temperature to be obtained must be derived from greater energy

employed. When we use diathermy we insolate the patient with blankets and sheets and there is no escape of heat. The temperature reaches a high point and is held there.

Another point to consider is the time element. Time is a factor as well as temperature. In carrying out further study, all of these questions must be met.

As Dr. Schmidt has pointed out also, the patient to be treated must have endurance. It was interesting to note the report of the Wassermann after the treatments.

One interesting point to consider in Dr. Carpenter's work is that rabbits do not perspire and you can therefore get the high temperature more easily. With human beings under the same conditions you would not get the same high temperatures. This is an important phase of the matter.

We are greatly indebted to Dr. Carpenter for his work and we hope he will continue his experiments.

INFLUENCE OF ULTRAVIOLET LIGHT ON THE GLUCOSE TOLERANCE OF RABBITS *

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There apparently is little known about the relation of ultraviolet light to glucose tolerance. A survey of the literature bearing upon this problem reveals two opposing points of view. One view is that ultraviolet light decreases glucose tolerance; the other, that it increases glucose tolerance. Rothmann (1923, 1925) reports an increased sugar tolerance after ultraviolet irradiations. Pincussen (1922), in his earlier work, apparently obtained a decrease in sugar in diabetic subjects. In his later work, Pincussen and Jacoby (1928), he reports a slight increase in blood sugar after irradiation of presumably normal animals. Ferri (1927) found that moderate doses of light, as shown by hyperglycemic curves after administration of glucose or injection of epinephrine, improves carbohydrate metabolism, but that larger doses impair the glucose assimilating mechanism. Messerle (1927) concludes that quartz lamp irradiation causes an increase (in aged persons) in blood sugar and a longer duration of alimentary hyperglycemia on ingestion of 20 grams of dextrose. Lippmann and Volker (1928) found no change in normal blood sugar after irradiation. In 3 out of 10 cases of diabetes they found a decrease in blood sugar after 20 to 40 exposures. Burge and Wickwire (1927) announce a decrease in sugar metabolism in *Paramecium caudatum* Ehr. after exposure to ultraviolet light, and interpret this as due to a destruction of insulin by the light.

In view of the conflicting evidence upon the problem of the influence of ultraviolet light on carbohydrate metabolism it was thought advisable to make a careful study of the glucose tolerance of rabbits which were subjected to ultraviolet irradiations and compare the results obtained with similar data from normal untreated rabbits.

Methods

All rabbits used were fed on a normal diet of hay and a feed mixture consisting of about 60 per cent cornmeal, 30 per cent oatmeal, and 10 per cent bran. A surplus of food was placed before them at all times in order to insure as near constant blood sugars as possible. According to Schwarz and Lubitz (1928) this practice will maintain quite constant blood sugar values. This was found to be the case.

The following procedure was employed in the study of the glucose tolerance: The rabbits were fasted for 18 hours before the administration of the glucose. Glucose was given to the animals through a stomach tube attached to a precision burette. Three grams of glucose per kilogram body weight were given. The blood sugar concentration was determined according to the Folin-Wu modification (1926). Blood for the determinations was drawn from the marginal ear vein into oxalated blood tubes. A sample of blood was drawn just before the glucose was given, and also one-half hour, one, two, three, and four hours afterwards. Control tolerance experiments were run on 12 rabbits one week before they received light. It was found by preliminary experiments that rabbits maintained more equal tolerances when tests were performed a week apart, rather than more often.

* (From the Zoological Laboratory of Duke University, Durham, North Carolina.)

Whether this is a matter of feeding or the influence of hyperglycemia as a result of the ingestion of glucose was not ascertained. When light was given the rabbits it was administered just after they had received glucose and prior to the first half-hour bleeding. They were irradiated for a period of from 10 up to 25 minutes, some receiving 10 minute irradiations, others 20 minute, and still others 25 minute. The source of light was a Burdick quartz mercury arc lamp maintained at a constant voltage, and placed at a distance of 90 centimeters from the rabbits. Two days before the animals received light the hair was removed from their backs by the application of a solution of barium sulphide. The glucose tolerance curves obtained when rabbits were irradiated were compared with the tolerance curves that were obtained a week earlier on the same individuals before they had received light irradiation.

Results

The results of this investigation are summarized in Fig. 1 which represents the composite curves of data from 12 normal rabbits. The curve representing the data from the control animals reaches its greatest height one hour after the glucose is given, and from that point recedes quite abruptly to approximately a normal level. This is true, also, of the curve representing the data obtained from the animals after they received light. However, the following differences between the two curves are to be noted: The blood sugar concentration of the rabbits after receiving light never reached as high a point as it did in these same rabbits before the light treatment; furthermore, the blood sugar concentration in the irradiated animals recedes to a normal level less abruptly than it did before they had been given light. In other words the curve obtained from light-treated rabbits is slightly flattened, and indicates that the tolerance of these rabbits for high concentrations of glucose is slightly increased.

Discussion

Although the results reported in this paper are not as conclusive as one might wish, nevertheless they indicate that rabbits receiving ultraviolet light have their tolerance for high concentration of glucose slightly increased. The mechanism of the action of light is not apparent. In a discussion of the nature of glucose tolerance curves Du Vigneaud (1925) reveals an interesting point of view. He offers the idea that there is a specific sugar-removing mechanism in the body which is stimulated to action by the incoming glucose, and quickly removes any excess from the blood. An examination of the curves obtained in this study reveals the interesting fact that both before and after the rabbits were irradiated the blood sugar concentration comes back to approximately a normal level in the same length of time. Since the peak of the curve for untreated animals is higher than that when they are treated with light, the rate of recovery beyond this point is greater in the former case than in the latter. In normal non-diabetic rabbits it appears that the rate of recovery is determined by the height to which the concentration of glucose in the blood initially rises. This has been observed by the author in numerous individual cases. If we assume that the mechanism for removal of glucose acts more powerfully when the concentration of glucose in the blood is higher, we have at least an explanation of the greater recovery rate in the rabbits prior to their receiving light. The results of this investigation perhaps lend support to Du Vigneaud's view.

If we were to hold to the point of view that there is a specific mechanism acting to remove excess glucose from the blood, we would say at once that ultraviolet light must favor this mechanism. The light must either have stimulated it to activity earlier than normally, or have caused it to act more strongly at a critical moment than it would normally. As a reresult, the sugar is removed from the blood in such a fashion that it is prohibited from reaching as high a concentration as in the rabbits before they had received a light treatment.

However, it would appear that it is not absolutely necessary to postulate that ultraviolet light acts on some intangible glucose-removing mechanism. If there is such a mechanism its efficacy depends not only upon itself, but, also, upon the various means by which sugar can leave the blood. As sugar is removed from the blood it must either be eliminated from the body by the kidneys, be oxidized, be synthesized into fat, or be stored as glycogen. Perhaps the effect of ultraviolet is to be found by looking in this direction. The true mechanism of the action of light can only be discovered by a critical study of the fate of the incoming glucose.

Fig. 1

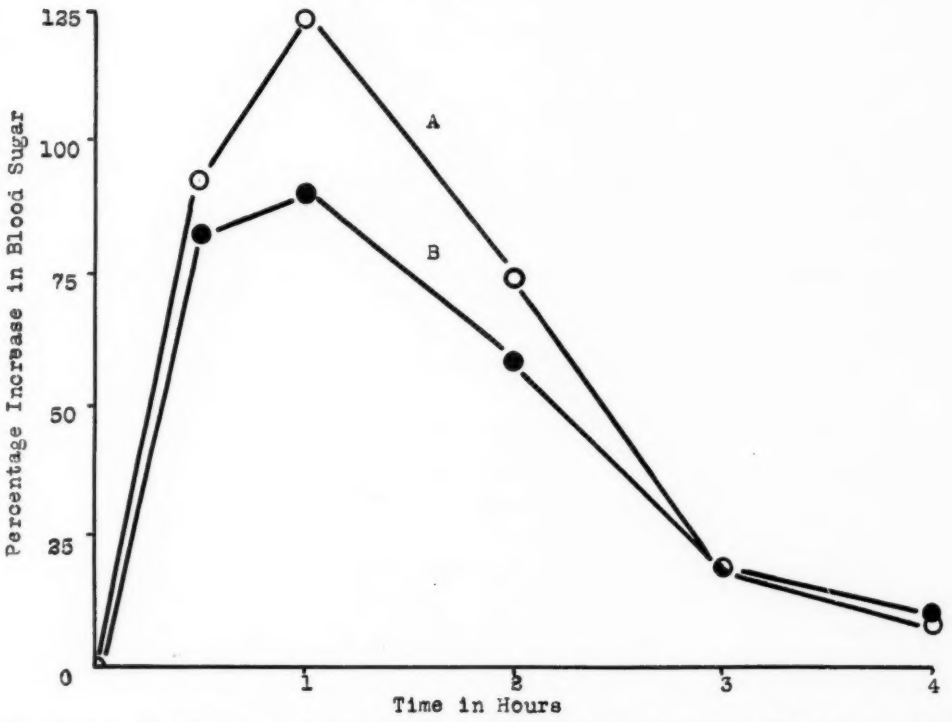

Fig. 1. Showing the influence of ultraviolet light on glucose tolerance of rabbits. Curve A represents results from rabbits before receiving light; curve B represents results from the same rabbits after treatment with light.

Summary

1. An investigation of the influence of ultraviolet light on the glucose tolerance of normal rabbits is reported.

2. Results of the investigation suggest that ultraviolet light increases the tolerance of rabbits for high concentrations of glucose.

3. The mechanism of action of the ultraviolet ray on glucose tolerance can only be discovered by a study of the fate of the incoming glucose.

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CANCER CONTROL FROM THE STANDPOINT OF THE PHYSIOTHERAPIST *

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Cancer causes one death of every ten. It ranks third as a cause of death and is surpassed at the present time only by heart disease and pneumonia. In 1900, 60 of every 100,000 of the population of the United States died from cancer; in 1927, 102 in every 100,000 died from this cause. The increase in the cancer death rate of the last thirty years has been partially due to better diagnoses and more complete and accurate death records. Especially is this true in the cities where the facilities for physical examinations are more adequate.

Cancer is found at all ages. Three of every 100,000 children under the age of five die each year from cancer. Then the rate slowly increases. At the age of fifty, 170 in every hundred thousand of the population die of cancer and at 75, 1,149 of every 100,000.

That "the most reliable forms of treatment (for cancer) in fact, the only ones as yet justified by experience and observation, depend upon surgery, radium and x-rays"[1] was agreed upon by a distinguished international group of students of cancer at a conference sponsored by the American Society for the Control of Cancer in 1926. The physiotherapist should be particularly interested in the treatment of cancer because of his familiarity with radium and x-rays.

Successful treatment of any disease condition depends on early and correct diagnoses, promptly followed by the proper therapeutic action. This is especially true in malignant disease where early diagnosis is absolutely an essential factor in its cure or control. When a cancerous condition in an individual is not discovered early, the chances for successful treatment are practically *nil*. The most skillful surgery is useless in the later stages when metastases, that is, the formation of secondary growths in other parts of the body, usually have taken place. X-rays and radium at this time are merely palliative in their action.

Three important types of tumors: bone, melanoma and breast, are of particular interest to the physiotherapist because of the dangers which may result following the improper use of certain physical therapeutic agents.

The malignant bone tumors constitute one of the most important departments of cancer treatment. They arise from cells which naturally produce one of the most stable of tissues, but are the most rapidly growing of all neoplasms. Ewing states in his "Neoplastic Diseases" that although most of these tumors are clearly connected with a traumatic origin, the mode of action of the trauma remains highly obscure. They are also associated with nutritional, inflammatory and infectious processes. They usually occur in early life and few appear after the third decade. This group of cancers, in general, has not received the proper initial physical examination when first brought to the attention of the physician. The presence of a cancerous condition has not been recognized and temporary therapeutic measures with such physical agents as electricity, baking and massage have been used to no avail. The cancer in the meantime has become extended and the possibility of control precluded.

Any persistent pain especially in the long bones is suspicious of bone sarcoma. Too often hasty diagnoses of rheumatism are made with such a clinical picture; and medication, baking and massage are employed. This is not only useless but dangerous, for such treatment may stimulate the sarcoma, if present, to a greater cell activity. The radiologic picture of bone sarcoma is characteristic; the affected area of the shaft shows erosion and often destruction of bone tissue. The taking of a biopsy, i. e., a specimen of tissue for examination, is serious as the necessary incision releases pressure which is usually followed by an acceleration of the growth.

The necessity for a careful analysis of every condition in which there is persistent pain in any of the bones, especially the long ones, is shown by the following case records,

* Read at the Ninth Annual Meeting, American Congress of Physical Therapy, St. Louis, September 10, 1930.

1 Cancer Control, Lake Mohonk Conference. Surgical Publishing Company of Chicago, 1927. Page 327.

taken at random from the Memorial Hospital in New York City.

A boy of sixteen, employed in an industrial plant, injured his shin by falling on a piece of slag. Pain and swelling resulted. Linament and massage were ordered by the company physician. The pain continued and in spite of this, skiing, skating and other physical exercises were ordered. An x-ray picture at this time was reported by the company physician as negative. Nine months later, with the pain still persistent, another physician recognized the condition as bone sarcoma, referred the patient to the hospital where the first x-ray plate was read and a diagnosis of osteogenic sarcoma of two-thirds of the tibia was made, followed by amputation. A year later and the patient is still receiving treatment.

In another case, an injury to the thigh was followed by persistent pain and later the formation of a lump. The patient was given sixteen electrical treatments by a local physician. Under this treatment the pain decreased but the lump continued to increase in size. A diagnosis was then made at the hospital of osteogenic sarcoma and radiation was given. The large mass, however, became necrotic from the radiation, and the affected leg was amputated. The patient has remained well for several years.

A woman, aged 63, with pain and stiffness in the right knee, diagnosed as arthritis, was treated for several months with diathermy, salicylates and aspirin. Three months later x-ray examination showed extensive osteogenic sarcoma at the lower end of the right femur. Following an amputation, colloidal lead and radiation treatment, the patient has remained free from disease for three years.

The treatment of osteogenic sarcoma is difficult and complex. The therapeutic test by radiation and the radiologic picture usually establish the diagnosis with sufficient accuracy. Amputation is indicated where preliminary radiation fails. Metastases occur very early in most cases. Because of the possible existence of sarcoma in conditions which in themselves seem insignificant, great care should be exercised in their diagnosis and treatment.

Malignant melanomas develop in a small proportion of the pigmented nevi or moles found in the skin or the choroid coat of the eye. Irritation by mechanical means or otherwise of these pigmented spots in the skin often leads to serious consequences. The pigmented mole or nevus, often has a long period of slow growth with finally a period of regression. After trauma, irritation or incomplete removal for cosmetic or other reasons melanomas sometimes develop. Stimulation of these melanotic areas may be caused quite innocently.

A man strained his back in lifting. He rubbed it for some time with Sloan's Liniment. Shortly after a dark chocolate colored mole or nevus about 2 cm. in diameter, located on the sacrum at the site of the injury, increased in size. A local physician applied a radium plaque to it when the nevus was about 5 cm. in diameter. As melanomas are very radio-resistant, no response took place. When the glands in the groin became enlarged they were dissected out and the melanoma extirpated. But the tumor promptly returned at the original site. It was again removed by a thermocautery. Soon after this the patient was sent to the Memorial Hospital where an x-ray examination showed metastases in the lungs and widespread dissemination to the regional lymph nodes. Radiation was then given but the patient died within a few months. Three years elapsed from the time of the original irritation to the death of this patient.

A cast placed too tightly over the fracture of the first metatarsal bone in the left foot of a man caused cyanosis and, following its removal, the patient noticed a small growth over the site of the fracture. The spot become progressively larger in size and became ulcerated several months later. Two months after this a lump appeared in the left femoral triangle and a red streak across the foot became noticeable. 26,000 millicurie hours of radium and two dosages of high voltage x-ray failed to control the growth. Death took place in two months.

Injury and irritation in both of these cases had stimulated a quiescent mole to an activity which defied treatment.

Melanomas are radio-resistant. They metastasize quickly, at which time treatment is of little avail. Early wide excision, however, sometimes effects a cure.

Many cancer specialists feel that manipulation of the breast during examination may be a factor in the dissemination of a carcinoma which at that time may be purely local. Rough handling of the breast may result in the dislodgment of carcinoma cells which are taken

by the blood stream or the lymph system to other parts of the body where metastases are later produced.

*Ewing in his "Neoplastic Diseases" reports the case of a woman whose breasts were examined for cancer by 21 different physicians. A tissue specimen, following operation showed multiple recent tumor cell emboli in the sinuses of an axillary lymph node. Extreme care therefore should be used during examinations in order to avoid the bruising of soft tissues, especially the breasts, and the possibility of dislodgment of carcinomatous cells which might form metastases elsewhere.

Agents, other than surgery, radium and x-rays have been of little value in the treatment of cancer. Electricity may palliate symptoms but it never cures and often adversely affects the tumor. The various violet-ray lights do not penetrate the skin to any depth. Diathermy and other heat applications are of little avail. Serums and extracts from various glands of the body have, so far, proved ineffective. Surgery, x-ray and radium at the present time are the only accepted methods of treatment of cancer.

The American Society for the Control of Cancer was organized in 1913 to collect, collate and disseminate information concerning the symptoms, diagnosis, treatment and prevention of cancer and to investigate the conditions under which a cancer is found and to compile statistics in regard thereto. The Society seeks to reach the medical profession with the definite message that many cases of cancer can be cured, if treated by modern scientific methods and at a sufficiently early stage in the disease. It distributes free literature describing different types of neoplasms and their treatment. It provides printed material on cancer, moving picture films and often speakers for medical society meetings.

Its state chairmen, who are representative physicians in each state and appointed by the Society, cooperate with the local Medical Societies and Boards of Health in the development of clinical and hospital facilities for the diagnosis and treatment of cancer. The state chairmen also carry on local campaigns to inform the public of the danger of ignoring the warning symptoms of cancer and urging early medical attention. They act as clearing houses for information on cancer for the medical profession and the laity.

The Society has made intensive surveys of the hospital and clinic facilities for cancer diagnosis and treatment in Georgia, Delaware, and Philadelphia, and in 61 other large centers of population. The amount of radium, the number of high voltage x-ray machines, the surgical equipment as well as the medical personnel are listed and evaluated. The field staff and the state chairmen, subsequent to these surveys, take steps to increase the facilities for cancer with the ultimate goal of at least one diagnostic and treatment center in each state or section of the United States with the standard of personnel and equipment agreed upon by the American Society for the Control of Cancer and the American College of Surgeons.

Thousands of pamphlets and other educational material have been distributed by the Society to the laity calling attention to the need for diagnosis and prompt medical attention when the cancer is in the early stage.

"Efforts toward the control of cancer should be made in two principal directions: (1) the promotion of research in order to increase the existing knowledge of the subject, and (2) the practical employment of the information which is at hand. Even with our present knowledge many lives could be saved which are sacrificed by unnecessary delay."

The Society believes that emphasis should be placed on the diffusion of definite, useful and practical knowledge about cancer and that the medical man can do much in the prevention of cancer by the detection of early symptoms which lead to cancer, referring patients to institutions and physicians who can make the proper diagnosis and apply proper treatment when the physicians themselves are unable to accomplish these results.

Discussion

DR. LOUIS H. JORSTAD (St. Louis, Mo.): I have listened to the essayist's exposition of the method that the American Society for the Control of Cancer has adopted in its fight against the spread of this dread disease with keen appreciation. His plea for intelligent cooperation by way of early recognition of the growth, its conservative management through surgical and radiation procedures appeals to all of us because we are convinced that that is the only logical method at our command. The problem of education is a dual one, namely, the education of the profession as well as the lay people not to dally

*Wood—Clinical Value of Certain Phases of Cancer Research. (Francis Carter Wood.) *Cancer Control Ibid.* Page 201.

with suspicious growths by measures that may stimulate or even delay the treatment. This offers the only hope for these patients. I cannot emphasize too strongly my conviction that in early diagnosis and early treatment rests the hope for palliation or cure. The selection of the proper treatment is the responsibility of the medical profession.

Dr. Harold Swanberg (Quincy, Ill.)*: This is the third time that I have had the opportunity of viewing this film. Each time that I have seen it I have gained increased appreciation for the work of our distinguished colleague from across the sea.

The lesson that I believe the film portrays to the physician that views it, at least the most forceful lesson, is the fact that radium under certain conditions does kill cancer cells. The great value of radium as a therapeutic agent is still unappreciated by a great many physicians today. It may sound strange, but many physicians think the use of radium is some form of hocus-pocus treatment. They cannot understand how a mineral encased in gold or platinum or silver capsules, covered with rubber, can influence tissue since the substance itself is not actually in contact with the tissue. They apparently fail to appreciate the laws of radioactivity and classify it in the same category as Abrams' electronic theory, or some other form of quackery.

It should be remembered that this film depicts the work of a bacteriologist and not a radium therapist. Dr. Canti is the bacteriologist at St. Bartholomew's Hospital in London. The problem he undertook was one of pure research and with no idea to boost any particular form of treatment. Of course, we have known for a number of years that radium under certain conditions does kill cancerous cells. The influence of radiation in the treatment of skin malignancies by radium therapists all over the world, for a period of at least two decades, and the splendid results we have received in this condition, proves in a clinical way that radium does kill cancerous cells. The further clinical use of radium in certain forms of sarcoma and carcinoma of the cervix offers additional proof of the effect of radiation in certain types of malignancies.

The issue, then, is not whether radium does cure cancerous cells, but it is in regard to the method of applying the radium, the question of filtration, the number of radium centers. Of course, the most important problem of all in cancer is that of getting the patient sufficiently early, when the disease is still a local condition.

I think this film should be shown before every county medical society. It would do much to overcome the prejudice that exists in some quarters against radiation therapy in the control of malignancies.

Dr. James Ewing, who name has been mentioned several times this afternoon (and I mention it again because I think all of us will agree that Dr. Ewing is one of America's outstanding students of cancer), in discussing the relation of radiation in the cancer problem, said a few years ago (and I will quote this): "One serious obstacle stands in the way of a prompt acceptance by the public of radiation therapy of early cancer and precancerous lesions, and this is the attitude of the medical profession against the new therapy. It is, on the whole, a matter of congratulation that a method so revolutionary should have received such prompt recognition the world over. Only the most tangible and overwhelming evidence could have compelled this recognition. The rapid adoption of radiotherapy must stand as evidence of the intellectual honesty of the medical profession. Yet, there is still another current of antagonism which reaches the public with much force, greatly impedes progress, interferes with the spread of knowledge, retards the acquisition of equipment and prevents many from receiving the benefits now available."

The Canti film, in my opinion, will do much to overcome some of the antagonism that has existed against radiation therapy, and I believe your society is to be congratulated in giving its members an opportunity to see this film, a film that many consider the greatest photomicrographic study that has ever been shown on the screen.

Dr. Julius Frischer (Kansas City, Mo.): I don't think that we should be too optimistic about our results, especially in the large cancers and the cancers that are not superficial, and those which involve the deeper structures, that is, the inaccessible structures.

No intelligent and well informed physician would attempt to make extravagant claims to a patient suffering from advanced cancer or to his family. In the twenty-five years that I have been practicing medicine I have come in contact, in many instances, with doctors who are incurable optimists who tell their patients and the members of their families that they are going to obtain favorable results in spite of many clinical signs to the contrary.

Radium in the hands of individuals that do not know how to handle it is a very, very dangerous agent. Roentgenotherapy in the hands of incompetent individuals is equally a very dangerous procedure.

In my work in urology I have come in contact with a number of cases, especially carcinoma of the prostate, carcinoma of the bladder and of the other genital organs, in which there has been a considerable amount of damage gone by radium and roentgen therapy. I have yet to see a permanent result from either one of these measures when the deeper structures are involved. By deeper structures I mean basal cell carcinoma and sarcoma involving the bladder and prostate. I believe that when malignant prostates are treated by radiation therapy the growth frequently becomes stationary. I have never personally seen a case cured. On the other hand much harm has resulted from the use of these potent agents by uninformed practitioners. Our cancer problem is yet to be solved. When that problem is solved, I believe that the millennium of the doctor will come.

Dr. H. G. Grosby (St. Louis, Mo.): In reading the essayist made mention of the fact that colloidal

* Discussion of paper of Dr. Louis H. Jorstad, "A Motion Picture Film Showing the Behavior of Living Tissue in Vitro and the Effect of Radium Upon Cancer Cells," published in *Archives of Physical Therapy, X-Ray, Radium with International Abstract*, October, 1930.

lead had been used. I should like to know in what form of cancer that would be used.

DR. ESTABROOK: There was a period several years ago when colloidal lead was used comparatively extensively in cancer. The results, however, have been, I should say, comparatively negligible, and at the present time colloidal lead is used very seldom. I think the people who have worked rather extensively with colloidal lead feel at the present time that it has no specific action in cancer.

In the case I cited of the woman who had sarcoma of the femur, colloidal lead was used with radiation, following the amputation. The colloidal lead was used at the request of her husband who was a physician but who, however, was not a specialist in cancer and knew nothing particularly about the effect of colloidal lead.

At the present time I know of no recognized institution either in this country or in Europe that is using colloidal lead to any extent in the treatment of cancer.

Question: How about the new serum that was developed on the West Coast?

DR. ESTABROOK: The question is, what has been the effect of the Coffey-Humber serum which was announced by Drs. Coffey and Humber in San Francisco in the early part of the year through the Hearst newspapers?

Up to the present time, the two gentlemen, Drs. Coffey and Humber, have not produced any evidence upon which to base any statement that they have either a control or a cure for cancer.

Dr. Coffey has been interested in hypertension for a number of years. We know that the secretions of the ductless glands do have a certain effect on the hypertension. The results which Dr. Coffey has claimed for his serum were at first incidental when he was using this extract of the adrenal gland in hypertension.

As you know, a cure for cancer in general is not accepted until the patient has passed a period of approximately five years following the treatment. That condition is demanded by the students of cancer as a period which must elapse. The Coffey-Humber serum has not been used for any length of time as yet. I can only answer the question by saying that at the present time there has been no evidence presented by Drs. Coffey and Humber whereby a decision can be made as to its value, if it has any.

It might interest you, however, to know that the method of preparation of the extract has recently been patented by Drs. Coffey and Humber, and the patent has been issued by the Patent Office in Washington.

There are, of course, quite a number of what we call our quack cancer remedies. We have a list in the office in New York, of quite a number of institutions scattered throughout the United States. They are not recognized by the local medical profession. They are not recognized by the American College of Surgeons or found in the list of hospitals approved by the American Medical Association, or by the American Society for the Control of Cancer.

There are, of course, a great many individual physicians who have cures, as they call them, for cancer. Some of them advertise extensively and secure patients. It is rather interesting that many patients write to us afterwards, wanting to know what to do following their course of treatment at these various institutions. Usually at the time they write us they have spent practically all their money and wasted months. Generally when the information comes to us, we can simply tell them that they are past the stage where they can be helped by any methods that we know of at the present time.

DR. LEWIS H. JORSTAD (St. Louis, Mo.): The kind of discussion that follows the Canti film always interests me. I have shown this Canti film about fifteen times. The type of discussion depends upon the type of group before which you present the film.

I tried to emphasize, I think, as I showed the film, that radium had a selective action but it wasn't a panacea. No one can conscientiously work with cancer for a long period of time without having most of his optimism knocked out. I appreciated the last discussion, and it is very well taken. I think anyone who conscientiously works with the idea in mind of curing as many cancers as possible is one who will use the standard methods at hand and not rely just on one. If he is not equipped to use more than one method, he should refer his patients to someone else. But I think it is terrible when a reputable physician will say that he can cure any kind of cancer with radium, for instance, or with x-ray.

The point brought out that radiation seldom eradicates, for a period of five years, deep lying malignancies is well taken, but that does not mean that we should absolutely ignore radiation. Surgery does not cure all of them. But oftentimes a combination of radium, x-ray and surgery does something which you cannot hope to attain by any one of those methods by themselves. The medical practitioner should be cognizant of that fact and have every one of those agencies available. I don't mean that he should be a surgeon, a radiologist and a radium expert, if there is such a thing, but that he should not be bigoted and feel that he should not refer his case to someone else.

That was the trend of the discussion following the Canti film today. But the point I want to emphasize is that the Canti film shows that with a certain amount of radiation there is a selective action on malignant tissue. However, with a smaller amount you may get acceleration, increased growth. We see that clinically. With a greater amount of radiation, of course, you will get destruction of all tissues. So the point is to know your cancer, know your patient and know your radiation, and then don't be afraid to admit that a certain disease does not fall into your category.

TREATMENT OF LARYNGEAL TUBERCULOSIS AT VEJLEFJORD SANATORIUM, DENMARK[1]

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AND

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This is to be viewed as only a preliminary report. Our object in publishing it is to indicate the value of co-operation between a phthisiologist and a laryngologist working together in a sanatorium in the treatment of cases with tuberculosis involving the larynx.

For several years one of us (Dr. O. Strandberg) has been treating patients (mainly ambulant panel cases) at the Oto-Laryngological Department of the Finsen Institute in Copenhagen, with universal carbon arc-light baths. These are sometimes combined with local surgical treatment. The patients are also controlled by a specialist in lung diseases, but do not get any special treatment for their pulmonary trouble. According to previous reports relating to this line of treatment, 55 per cent of cases with laryngeal affection underwent healing, and many of them had no relapse for a long time; 55 per cent is quite a large proportion as compared with previous statistics, but it is probable that the percentage would have been higher if the treatment had been carried out in a sanatorium where the lung affection would also have been attended to in a rational way.

One of us (Dr. Gravesen), in conjunction with Dr. Godbey, published recently an article on the complications of laryngeal tuberculosis as investigated in the Vejlefjord Sanatorium*, and compared the results with those obtained in the Finsen Institute. Our statistics showed that the results of treatment of laryngeal tuberculosis at the Finsen Institute were better than those obtained at the Vejlefjord Sanatorium, while in the case of patients with the lung disease the results were opposite.

Our co-operation, which has been the outcome of an endeavor on both sides to create the best possible conditions for a group of patients, where the prognosis has hitherto been considered very gloomy, was started three years ago.

There has been no selection of cases. Whenever a tuberculous laryngeal involvement was diagnosed, the administration of light baths was started at once, unless there was an immediate indication for some form of special treatment for the disease in the lungs (*e. g.*, sanocrysin, operative measures, etc.), when the use of light baths was postponed for a few weeks.

The form of light bath employed was the carbon arc of 25 amperes, in series of three. Exposure to begin with was for five to ten or fifteen minutes according to the general condition of the patient. This was gradually increased in the course of about two weeks to full time (*i. e.*, 1½ hours four times a week). This was continued as the only treatment for the laryngeal affection until the patient had become afebrile, with a good gain in weight, and with a series of sedimentation tests showing a steady fall. If at that time there still remains any disease in the larynx, local treatment is performed, and never before, as according to Dr. Strandberg's experience, local intervention may do definite harm if it is performed in an earlier stage when the disease is still active. The patients under treatment are also enjoined to maintain rest for the affected part, whispering only being allowed.

Special treatment of the lung involvement is carried out at the same time. Fever is not considered a contra-indication to actinotherapy as some phthisiologists assert. In no case have we noted prolonged fever which could be attributed to light treatment. On the contrary, we have observed in many cases that fever subsided during the conduct of the light treatment. The temperature often rises at the beginning of a course, but we have never seen bad effects from this reaction. Light baths are often objected to on the

[1] Extract of paper read before the Scandinavian Tuberculosis Congress at Helsingfors, Finland, in July 1929. Courtesy of *British Journal of Tuberculosis*, April 1930.

* See *Tubercle*, July, 1927.

ground that they produce a harmful effect on the tuberculous lesion in the lung. We have certainly often observed a quicker formation of a cavity during light treatment, but it is doubtful if it is really to be considered an aggravation of the disease. We think that the lung affection passes more quickly through such developmental phases, as must in any case occur. In view of this explanation we would emphasize the importance of combining light treatment with treatment of the lung affection, particularly by collapse therapy when considered desirable. By working on these lines it will be seen from the following statistics that a very satisfactory result can be obtained as regards the lung affection also. No case showed fresh dissemination of the disease in the lungs due to light baths to any greater extent than might be expected from the previous character of the lesion.

It must be pointed out that in our comparative small group of statistics only cases which have been discharged or have died are included. Our cases numbered 69 with lung and laryngeal tuberculosis. Of these, those with ulceration in the larynx numbered 47, and those with infiltration without ulceration 22.

On the whole results with regard to laryngeal tuberculosis in these 69 cases were as follows: deaths 4. Of these the tuberculous involvement of the larynx—worse 1; improved 1; healed 2. Of the remaining 65 discharged cases, all of whom had definite affection of the larynx, the results were as follows: affection in the larynx — worse 1; stationary 1; improved 4; healed 58.

It must be admitted that these numbers are rather small for expression in percentage form. But if our results are so expressed, then 84 per cent were discharged with clinically healed laryngeal tuberculosis. (The two cases who died of their lung disease in the sanatorium had the lesion in their larynx healed, but are not included in the percentage.) In some patients, though the laryngeal affection did not quite heal during the light treatment, there was relief as regards pain and diminution in the difficulty in swallowing. The average number of light baths given in the case of the "cured" patients was 57. In 12 cases local surgical intervention had to be carried out one or more times.

Of the 58 patients with healed laryngeal affection, 2 had a relapse after 13 and 18 months respectively. Both of them returned to the sanatorium for treatment, but died later; 3 patients died of progressive pulmonary tuberculosis after their discharge. Thus 53 cases were left for observation. We readily admit that the period over which our observations have extended has been very short, as our cooperation only started 3 years ago.

We can give an analysis of results as regards these 53 cases as follows:

Under observation for less than 6 months 17 cases; for from 6 to 12 months 19 cases; for from 1 to 2 years 14 cases; for more than 2 years 3 cases.

The net result of sanatorium treatment in 61 cases discharged with healed laryngeal affection is as follows:

Considerable improvement in lung condition, with permanent negative sputum † 30 cases; improvement in lungs and in general condition 26 cases; worse 3 cases; died 2 cases.

As regards bacilli in the sputum, examination showed the following:

Before treatment—positive (T. B. +) 55 cases; negative (T. B. —) 6 cases. Out of 55 "positive" sputum cases T. B. disappeared permanently in 26 (47.3 per cent).

In order to find out if an effective treatment for laryngeal complication resulted in any harm to the lungs in patients with healed larynx affection the changes in the lungs were checked by combined physical and X-ray examinations at the beginning and at the end of the course of light treatment. The results are as follows:

Considerable improvement in lungs during light treatment 39 cases; lung affection the same at the beginning and end of light treatment 15 cases; lung affection aggravated during light treatment 7 cases. (Two of this group improved later on after the adoption of the collapse therapy.)

A sedimentation test was carried out in 57 of our cases with healed larynx affection: before the light treatment it was on the average 29 millimetres after 1 hour; after light treatment 11 millimetres after 1 hour.

We venture to set forth our conclusions as follows: In spite of the different social standards in the group of patients, we feel justified from the above recorded figures in concluding that a combined treatment of the tuberculous lesions in the lung and larynx under sanator-

† Permanent negative sputum means at least six consecutive negative examinations within six weeks.

ium conditions is a method of choice. The statistics we have given will be of service for comparison. One group from mainly ambulant panel patients, the other from immates of a private sanatorium. It is obvious that the permanent results in the two groups may be somewhat different later on. But the social difference should not be considered to have any influence on the percentage of the primary healing. The first set of statistics shows a percentage of 55, in the second it is a percentage of 84. It seems that the combined treatment we advocate, when carried out in a sanatorium, gives a percentage of cures 30 points higher than in those cases who have special treatment carried out for the laryngeal complications only. We believe we have proved the value of co-operation between a phthisiologist and a laryngologist in sanatorium work, and we would strongly advocate the adoption of this course in all cases of tuberculosis where there are both pulmonary and laryngeal lesions.

ULTRAVIOLET GLASSES

CAPTAIN A. R. WOOD, M.A.

ST. HELENS, LANCASHIRE, ENG.

Window glass is an important building material which has been manufactured from ancient times to keep out the weather and to let in the light. There are three necessary properties of any window glass: it must be:—

1. transparent to visible light,
2. of good quality—free from defects,
3. permanently resistant to the weather.

Glass is remarkably transparent to visible light—Sheet Glass and Polished Plate transmit 90% of visible radiation. The question then arises, is this the only kind of radiation that we want glass to transmit? What other kinds are there which reach us from the sky, and which of them do we want to be transmitted?

Visible light is energy propagated by electromagnetic wave motion, and its properties are determined by its wave length, as is true of all such radiation. The range of the electromagnetic wave length is enormous. We have the wireless waves, thousands of metres in wave length: the beam wireless waves of about 30 metres: the infra red radiation of the order of 1/1000th of a millimetre: then visible light, whose wave length is measured in Angstrom units from 7600A to 3900A: below these the ultraviolet: then X radiation: radium gamma rays —a small fraction of an Angstrom unit, and cosmic rays, which are far shorter still. Some of these forms of radiation reach the earth's surface through space, and some can only be produced artificially. The ultraviolet we know can be produced by the arc lamp and its existence shown by fluorescent materials.

The value of sunlight has been known for thousands of years, but the reason for the benefits derived from the sun were not understood until comparatively recently. Finsen started the treatment of lupus by exposure to arc lamps, and thus drew attention to the probable value of the ultraviolet in sunlight. The treatment of tuberculosis has been developed enormously during recent years in this country by Sir Henry Gauvain, who has designed a special ward for sunlight treatment —a development made possible by the use of glass which transmits the ultraviolet. The work of Rollier in Switzerland, and the remarkable results obtained by sunlight treatment of surgical tuberculosis, are known all over the world. The prevention and cure of rickets is another most important result of exposure to sunlight. It is now known that the mechanism of this prevention is the formation of vitamin D from ergosterol in the skin due to irradiation by the shortest wave lengths of the solar spectrum. Vitamin D is necessary for the absorption of calcium.

It has been shown that the important part of sunlight which produces erythema and increases the bactericidal power of the blood is that of wave length 3000A and its immediate neighborhood, that is, from 3000 to 3200A. Using artificial radiation, Dorno showed that the maximum erythema producing wave length is 2980. It is these wave lengths that also produce vitamin D from ergosterol: thus these are the wave lengths which we should receive from the sun. The solar spectrum extends down to 3000A as a practical minimum.

Dorno found that in Switzerland in July at mid-day the shortest wave length was 2950A. There is a wide variation both in end point and in intensity with the altitude of the sun. Also there is an enormous increase of energy with increasing wave length in the solar spectrum, wave length 3130A being of the order of 1000 times more powerful than wave length 3000. Thus, although erythema production by wave length 3000A, for equal energy, is probably 20 times as great as that by wave length 3130A yet, allowing for energy difference, wave length 3130A is 50 times more effective.

Why does the solar spectrum end at about 3000A? Professor Fabry has shown that oxygen, nitrogen and water vapour are quite transparent to the short ultraviolet, also that radiation 2537A will travel several miles at the earth's surface; yet observers in a balloon at over 29000 feet could only detect wave length 2890, and originally concluded that no shorter wave length came from the sun. But we know that the sun and other stars are at a very high temperature and must send out short ultraviolet. It is now known that the cutting off of the shorter radiation is due to a layer of ozone at a height of many miles above the earth. Professor Fabry showed that this will cut off completely all the very short radiation. Thus the important part of the ultraviolet received from the sun is that between 3000 and 3200A. It is a remarkable fact that ordinary window glass cuts off the whole of this "health band", being opaque to radiation below 3200A.

The question is often raised as to whether we receive this important radiation in this country.

Work was carried out on this subject by the National Physical Laboratory, Teddington, from July 1929 to July 1930. In December they reported that up to that time the shortest wave length received on dull November days, detectable by a visual examination of the plates exposed, was 3050 or 3060, while on a day when there was a thick white fog, the end point was 3080. The shortest wave length detectable by a visual examination of the plates exposed during mid-summer was 2960. Photographic printing paper, used in conjunction with a thin screen of metallic silver, will show very clearly that throughout the winter there is radiation in the neighborhood of the health band which comes through ultraviolet glass, but fails to penetrate ordinary window glass. The silver screen is made thick enough to be opaque to visible light, but transmits radiation in the neighbourhood of the health band. The difference can be shown on the dullest winter day. This clearly indicates that we need ultraviolet glass in this country, even in winter, and that one receives more ultraviolet behind a transparent glass in winter than one does on the brightest day in summer behind ordinary glass.

The demand for ultraviolet glass in quantity first arose in 1924. Lamplough made the first melts of "Vita" glass—the only British ultraviolet glass—and the first made on any scale. Some continental glass was made in small quantities before this, but it was very expensive and used chiefly for laboratory purposes.

The degree of transparency of these glasses is of the first importance. It is not an easy thing to measure without special apparatus, and it is not surprising that in the early days there was a good deal of controversy as to the percentage of radiation transmitted by various glasses at different wave lengths. Also, different melts of the same general composition vary slightly from sheet to sheet. It is quite useless to send one isolated sample to a competent authority for test: testing of a single sample is no criterion of the general run of any make of ultraviolet glass. It is necessary for the manufacturer to set up very accurate apparatus and to keep a constant control of his product.

The chemical difference between ultraviolet glass and ordinary window glass is found to lie in the minor constituents. Early investigators naturally tried the effect of substitutions in the major components, but these were found to produce very little difference. The effect of iron in the ferric state is by far the most important factor in the manufacture of these glasses. Ferric iron is completely opaque to all ultraviolet radiation below 3200, when present in even extremely minute quantities. Thus every possible precaution has to be taken by the manufacturer to exclude iron, and as iron is present in all his raw materials, and to a much greater extent in the vessels in which he founds his glass, it is clear that he is faced with a most difficult problem.

Up to about a year ago there was a great deal of discussion about the loss of transparency of these special glasses upon exposure to sunlight. The facts are that there is a small loss on exposure to sunlight, but the trans-

mission is then permanent and the glass is still transparent throughout the whole length of the solar spectrum. The early errors were caused by the statements by many physicists that exposure to the quartz mercury arc lamp for a short time would produce the same effect as prolonged exposure to sunlight. This is now realized to be quite fallacious: the short wave length radiation from the arc produces far greater deterioration than does the solar ultraviolet. Glass which has been degenerated by exposure to the lamp, when placed in sunlight actually recovers about half of its lost transparency. This process can be brought about also by shielding the degenerated glass with ordinary window glass and exposing it further to the arc lamp.

As regards the mechanism of these changes in transparency, we know that ferric iron is responsible for stopping the ultraviolet, and that ferrous iron is quite transparent. The opacity is therefore produced by oxidation of the ferrous portion of the iron to ferric, and the rejuvenation of the glass is apparently brought about by the reversal of the process by longer wave length radiation. (*Nature*, 21st September, 1929.)

The effect of dirt upon these glasses has been much exaggerated: the diminuation in transparency is found to be practically independent of wave length. Thus it is only necessary to clean the windows when they are becoming opaque to visible light, that is, when they are obviously dirty.

The permanence of glasses is another matter of the first importance. Glass, which contains a considerable quantity of alkali, sodium or potassium, is naturally soluble to some extent in water. The amount of alkali is the chief deciding factor as to whether the surface will be decomposed by water: iridescence, due to a decomposed film, can be seen frequently on some old windows. The tendency of all glasses to decompose can be compared very conveniently by treating the specimens under steam pressure in an autoclave under identical conditions. Some manufacturers are tempted to introduce far too much soda in their glass in order to produce easier melting conditions. The glass is less viscous: the bubbles rise better and the glass is finished more quickly. This has an important bearing upon the behaviour of ultraviolet glasses. Iron is absorbed during the founding of the glass: therefore glass with high soda is likely to contain less iron because it is finished more quickly. This is what has been done in many cases on the Continent, with disastrous results to the behaviour in the autoclave. Thus all ultraviolet glasses are a compromise—high soda content tends to give high transmission of ultraviolet radiation and, given good workmanship, a good quality glass, but it is a most dangerous constituent, making the glass unstable and liable to develop an iridescent film.

INCREDULITY AND WISDOM

Aristotle was right when he said that "incredulity is the source of all wisdom." You should think for yourselves — closely, carefully, patiently and independently upon everything that may come under your notice, that may be at all cognate to your profession, and never be satisfied that you know enough about anything as long as anything about it remains unknown. Take nothing for granted that may seem inconsistent with correct reason or established facts, simply because some one of acknowledged authority may have said it, and reject nothing as unworthy of your investigation on account of its apparent insignificance, or because it does seem to square precisely with the preconceived theories of the faculty. . . . In short, the man who makes himself truly great in any calling is the one who has sense enough to know a good thing when he sees it, and decision of character enough to make it useful whenever he may find it.

Whatever you may accomplish, however, in your professional career, you should make up your minds not to be surprised to find yourselves deprived of much of the credit that may be justly due you. In your profession, as in all others—

"Full many a flower is born to blush unseen,
And waste its sweetness on the desert air;"

While, on the other hand, full many a name shines upon the envied page of history with a borrowed light to which it is not entitled, and which its owner himself would not pretend to claim.

—*J. Proctor Knott, Governor of Kentucky, in The Journal of the American Medical Association, October 4, 1890. Ab. A. M. A. Bulletin,* 25:1 (December) 1930.

GLEANINGS FROM SCIENCE*

The Nobel Prize in chemistry was awarded to Prof. Hans Fischer of Munich for his achievement in the laboratory production of hemin, one of the components of hemoglobin, the red coloring matter of blood.

A device for measuring the intensity of ultraviolet rays by means of an ultraviolet-sensitive photoelectric cell connected with a condenser, which as it discharges operates a counter, was developed in research laboratories of the Westinghouse Lamp Co.

The William H. Nichols Medal for 1930 was presented by the New York Section of the American Chemical Society to Samuel E. Sheppard of the Eastman Kodak Company for his "outstanding achievement in the chemistry of photography."

A new theory of the universe, assuming that it is non-static and consisting of matter dissipating through radiation, was propounded by Dr. Richard C. Tolman, of the California Institute of Technology.

In recognition of his demonstration that protons act like waves, Prof. Arthur J. Dempster, of the University of Chicago, was awarded the $1,000 prize given annually by the American Association for the Advancement of Science, for an outstanding paper presented at its meeting.

The possibility that the whole universe is fading away so that in some timeless future no matter will remain, only radiation, was indicated by calculations made by Dr. Louis S. Kassel, of California Institute of Technology.

Fever produced by short radio waves was found helpful in the treatment of paresis by Prof. T. W. Richards of Princeton.

The 1930 Nobel Prize in medicine was awarded to Dr. Karl Landsteiner of the Rockefeller Institute of Medical Research for the discovery that human blood is of four different types and that blood of one type does not always mix with blood of another type.

For his researches on light, particularly the discovery that monochromatic light when scattered by shining on certain transparent substances is partly changed to other colors, Sir Chandrasekhara Venkata Raman, professor of physics at the University of Calcutta, was awarded the Nobel Prize in physics.

Artificial gamma rays, which may take the place of radium in the treatment of cancer, are produced by a giant vacuum tube operating at 700,000 volts, at the California Institute of Technology.

The theory that the sun is lighted like a giant electric bulb by electricity under pressure of ten million volts flowing from inside the sun and heating its atmosphere to incandescence, was advanced by Dr. Ross Gunn, U. S. Naval Research Laboratory.

That space is not empty but filled with electrons of minus or negative energy, was suggested by Dr. P. A. M. Dirac of Cambridge, England.

The time required for blood to clot, vitally important in surgical operations, is shortened by feeding the patient vitamin D, it was discovered.

Dr. R. A. Millikan found that measures of the intensity of the cosmic rays provide a good means of determining the amount of atmosphere above a point on the earth, so that the cosmic ray electroscope may be used as a form of barometer.

* *Science News Letters*, Dec. 27, 1930.

ARCHIVES of PHYSICAL THERAPY, X-RAY, RADIUM

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EDITORIALS

MODERN CONCEPT OF INFRA-RED RADIATION

That chemistry and physics are sciences which have led to a common meeting ground is hardly to be disputed. And where that meeting ground touches the province of pharmacology, it becomes increasingly more difficult to distinguish the category of chemical phenomena from that of physical phenomena. Indeed, there is much evidence to show that at least from the viewpoint of the pharmacologist, chemistry is the science of effects and physics is the science of structure.

For example, Professor Abel's epinephrin is chemically identical in either of its optically active forms; but a comparison of the natural levorotatory with the dextrorotatory form, according to Cushny (1) shows the former to be from twelve to fifteen times more reactive on the sympathetic ends in the vessels than the dextrorotatory form. Biochemists and biophysicists have realized for a long time that most all biologically important chemical compounds occur in optically active forms. The sugars, the amino acids of the proteins, important sterols like cholesterol and ergosterol, the alkaloids, the protein solutions designated toxins—all show optical activity. This is in distinction to the synthetic chemical equivalents of these various products which, for the greater part, are invariably synthesized in an optically inactive form; and because of this optical inactivity, they show often a strikingly less potent, sometimes different, and occasionally no physiological activity.

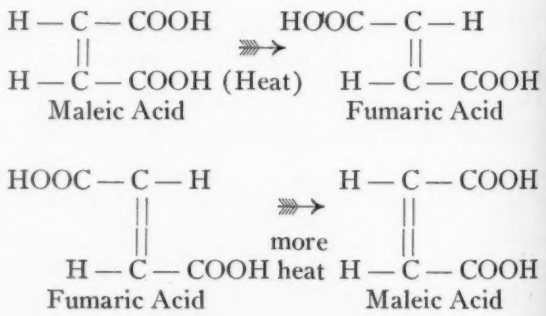
A compound that is optically active may exist in one of three forms; it may rotate plane polarized light to the left (anti-clockwise), in which case it is designated levorotatory; it may rotate polarized light to the right, when it is designated dextrorotatory; or, it may not rotate light at all, either to the left or to the right, in which case it is designated optically inactive. In the case of optically inactive compounds, as the brilliant work of Pasteur indicated, the fact is that the compound is a mixture of equal amounts of

the levo- and dextro-rotary forms; and since the amounts are equal, the effect of the mixture is that of rotating as much to the right as it does to the left, resulting in an exact neutralization of one or the other forms of rotation.

Any cursory review of physiologically active compounds reveals at once that of the three forms in which they occur, the optically inactive form is without exception less vigorous in its physiological effect than one or the other of the optically active forms. Cushny has reviewed these relations in an excellent monograph which can profitably be consulted (2).

It has long been known to chemists and physicists that quite often an optically active compound is transformed to the "racemized" form usually by heat alone (3), (4). By racemized is meant the neutralization of optical activity. Pasteur, for instance, prepared racemized or optically inactive tartaric acid merely by heating the levorotatory form. Nicotine, which is ordinarily levorotatory, loses its levorotation and becomes racemized merely by heating; and in so doing it diminishes in toxicity (5). There is no limit to the number of examples that can be obtained from the literature which parallel exactly the two examples mentioned. Another one, deserving of mention, is the case of histamine hyprochloride. It is optically active. In extremely dilute solutions, so dilute as to elude chemical detection, histamine hydrochloride produces instant and marked contraction in unstriped muscle, such as the gut of the guinea pig. There are some who see a relation in the action of histamine hydrochloride and in the clinical syndrome generally designated anaphylactic reactions. But if the solution of histamine hydrochloride is exposed to infrared rays, and thereby slightly heated, it loses optical activity and its power to contract muscle lessens, and can even be extinguished. Chemists have designed these racemizations in general as belonging to a type of action called the Walden inversion; and in every laboratory where organic chemistry is practiced and studied the Walden reaction is universally employed specifically for the purpose of racemizing optically active compounds. The Walden inversion does not discriminate between compounds that are physiologically important and compounds that are industrially important. It racemizes wherever racemization is possible.

Realizing fully the great significance of the Walden inversion, it seems possible to predicate a somewhat obvious and yet heretofore unmentioned significance in a mechanism that may apply to the clinical use of infra-red radiation. To be sure, infra-red radiation is not heat. It becomes transformed into heat when it strikes an absorbing body. During this absorption it can readily rotate molecules that are pivoting on the double bond of connecting carbon atoms; and the pivoting changes the optical rotation. The classical example is the transformation of fumaric to maleic acid. When maleic acid is heated it becomes transformed to fumaric acid; but the reaction can be carried to excess because very prolonged heating will in turn reconvert the fumaric acid, at least in part, to the original maleic acid. The space arrangement of the molecules undergoing the inversion is assumed to be as follows:



The physiological properties of fumaric acid are different from those of maleic acid, and thus it comes about that infra-red is capable of changing the physiological reactivity of a known compound. The example is excellently chosen since it illustrates perfectly well some of the clinical experiences that are seen in the treatment of various conditions with infra-red radiation. Thus, a moderate degree of heating permitted to endure for a comparatively long time, about an hour, produces a Walden inversion of the maleic acid; but if the heating is too vigorous or if it is too prolonged, a part of the inversion reverts to defeat the original purpose. So it is in the clinic; the application of comfortably tolerant infra-red radiation to an acute sinus for a period of about an hour produces remarkably instant beneficial effects. But too

rapid heating, or too vigorous heating may oftentimes produce no effect at all, or even aggravate the symptoms. It is perfectly conceivable that in the beginning acute infections, perhaps even in the chronic infections, minute amounts of physiologically potent biological compounds are formed. They may be histamine hydrochloride in anaphylacetic shocks. They may be substances akin to the alkaloids where toxemia is profound and central nervous symptoms are displayed. Whatever they are, there is every reason to assume that they show optical activity, as do practically all the products of living phenomena. And if they show optical activity they cannot be expected to form exceptions to the well-known Walden inversion.

Whereas hyperemia, sympathetic nervous system effects and probably obscure mechanisms are charged with the benefits that infra-red radiation may produce, it must be said that there is practically no evidence to indicate just how hyperemia and sympathetic stimulation operate. But the Walden inversion is a fact. It operates successfully in the test tube on every variety of biologically active compound exposed to infra-red radiation. And thus, the clinician, particularly the physical therapist may look for an interpretation of such benefits as he produces with infra-red radiation in terms of fundamentally established physical chemistry, much as he has explained some of the actions of ultraviolet in exactly the same way.

Infra-red, which is not heat, but which can be converted into heat, is still the prime mover of every chemical reaction; and the human race are still warm-blooded mammalians.

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ELECTROCUTTING INCISIONS AND THE HEALING OF WOUNDS

What has heretofore been considered as one of the desirable features of Electrothermic surgery, namely, the pliability of the resulting scar, has recently been subjected to newer evaluations in connection with studies of the healing quality and tensile strength of wounds so incised. Investigations of such nature have been published by Ellis,[1] in consequence of personal experiences that suggested the need of more definite clinical information on this particular phase of the action of electric cutting currents. It is but logical that with the advent of this new cutting phenomenon in electrothermic surgery some of the well recognized advantages associated with electrocoagulation and desiccation would again be subjected to critical interpretation. The basic effect of this modern innovation to surgery has thus far stood the test in every instance.

Its ability to bloodlessly incise or excise tissue with the readiness of a cold scalpel has had generous recognition and confirmation. Progressive surgeons have recognized these fundamental advantages with commendable speed.

Electrotomy is at present utilized by leading operators in some of the most difficult and delicate surgical situations on account of these basic reactions, i. e., its bloodless cutting qualities and its shock inhibiting properties. Because of these outstanding effects, electrosurgery is now employed in increasing volume in situations where bloodless surgery is of paramount importance and of greatest advantage to the patients. Says Ellis, "The use of the cutting currents with just enough desiccation to control capillary hemorrhage without resulting in coagulation and slough has made justifiable many surgical operations in easily bleeding fields that would formerly have been considered foolhardy." It has thus revolutionized the surgery of such regions where only the most skillful or intrepid have heretofore ventured to explore. The operative risk of brain surgery has been materially modified and made less hazardous with the use of this agent. It is no secret that Cushing's[2] enthusiasm has in no way diminished with his increasing experience in the application of electrotomy in surgery of the brain.

Other highly specialistic fields of surgery are now reporting favorable experiences with electric cutting currents. The bloodless separation of intrapulmonary adhesions has long been an ideal toward which modern surgery has been striving. Intrathoracic surgery has been in need of a bloodless method of operation. The pioneer work of Bettman[3] in this direction is now being confirmed by many independent workers. Electrosurgery has here made it possible to transform what has long been regarded by many conservative men as an adventurous exploration to a procedure of relative safety.

An innovation that carries with it great potentialities for good has been the introduction of the so-called "tunneling" operation by Caulk,[4] and Collings,[5] in connection with prostatic involvement. Any method that can reduce the post-operative morbidity and risk associated with prostatectomy is considered a contribution of great moment to surgical urology. Although the applicability of the "shredding" or "tunneling" method is at present restricted in its indications, the possibilities of its more extensive applicaton has been only a question of more perfected cutting electrodes and wider experience with the method. On the other hand, one of the greatest recommendations for the use of electrocutting resection has been its shock reducing properties. Its ability to obtund local nerve impulses no doubt will act as a deciding factor for its more liberal use in future prostatic surgery. Modern urologists have played a progressive part in the popularization of surgical diathermy and, by the same token, it can be assumed that the electric cutting knife will receive the same enthusiastic support from its ranks in future years.

Because of the above enumerated properties possessed by this type of current, modern surgery has constantly extended its application to deeper structures, and to malignancies beyond the indication of the older electrosurgical measures. It is needless to cite *in extenso* the large field of indications that is at present being developed for this agency. Those familiar with its progress realize that it is gradually replacing classical procedures in many branches of surgery. Theoretically it should be the procedure of choice in most operations associated with malignancies and poorly controlled bleeding areas. The sealing of capillaries and arterioles is a feature most desirable in connection with situations mentioned above.

But surgery would eventually defeat its own endeavors if healing of the wound was definitely retarded by this or any other measure. If the tensile strength of the healed wound should, for example, fall below the normal level necessary for tissues to carry on their normal function, the benefits of electrothermic procedure, no matter how spectacular its appeal, would be completely valueless. It was inevitable, therefore, and consistent with the trend of surgical progress that the healing problem, no less than the problem of its bloodless cutting properties, should come in for critical evaluation; and this is but a logical complement of the other. The work initiated by Ellis, therefore, begins to round out the entire problem under discussion. It has contributed information of practical value to the surgeon by first stripping much of the redundant speculation associated with its spectacular action and by adding to it data of a positive nature.

The point of interest in the foregoing study is the deduction that electrically incised tissues are prone to heal with sufficient firmness to withstand tensions not frequently encountered under ordinary circumstances. It is also significant that "The stomach and muscle incisions electrically produced show the same percentage of primary union as the scalpel wounds." The stomach, however, has its weakest healing gradient in the second week, but the "muscle wounds are of almost equal strength with the scalpel wounds through the entire healing period."

The foregoing studies of Ellis may be ranked among the most valuable contributions to the newer surgery. It has materially broadened the scope of this new auxiliary measure by indicating its safe extension to the surgery of the deeper organs as well as muscle structure. We are in accord with the final conclusions of Ellis, namely, "While these observations do not argue against the employment of the electrosurgical knife for making surgical incisions when clear-cut indications for its use present themselves, this method cannot be considered as a practical substitute for routine use."

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ULTRAVIOLET RADIATION IN DISEASES OF THE EYE

From time to time articles have appeared in the medical literature concerning the use of ultraviolet in diseases of the eye. Contributions have been made by Duke-Elder, Birch Hirschfeld and others. Corneal ulcers of various types have been successfully managed by ultraviolet, and special apparatus has been devised for radiation therapy. In this country ophthalmologists have been slow in experimenting with this newer method and the reports are too few to those appearing in foreign journals.

A recent contribution by Furniss [1] merits some comment at the present time. An important consideration referred to at the outset is that a course of sunlight treatment, natural or artificial, is of very great value in eye diseases due to constitutional states. "Some ophthalmologists advise this form of ultraviolet therapy instead of direct local phototherapy. The best results are probably obtained by a combination of both methods."

Furniss emphasized the fact that in the earlier acute state general phototherapy frequently does more harm than good and relapses are likely to occur. "The best time to begin treatment appears to be immediately after the acute symptoms have passed, before the disease can be definitely labeled chronic, and before the lesion is complicated by extensive tissue degeneration or destruction or by the accumulation of massive organized deposits rendering restoration impossible."

There are five diseases listed by Furniss which have been successfully treated by irradiation. These are conjunctivitis, blepharatis, diseases of the cornea, trachoma and tuberculous lesions. The method employed for local irradiation is limited to the treatment of the anterior segment. It is contraindicated in diseases of the inner eye excepting those cases of iritis showing nodules on the anterior surface of the iris. Attention is directed to the reaction on the cornea. Photophthalmia, manifested by pain, photophobia, lachrymation and blepharospasm have to be dealt with. Furniss opinionizes that the pain is caused by irritation of the nerve endings in the cornea after the trauma to the epithelium and that the appearance of haloes is due to corneal edema.

The use of ultraviolet irradiation for trachoma is of special interest. This ophthalmic disease has caused the ophthalmologist unsurmountable difficulties at all times so much so that he is always willing to listen to the suggestion of a new procedure which offers improved results. The technic is simple and its purpose is to leave the conjunctiva smooth and free from follicles. The quartz rod which is used locally directing the rays of the lamp to the lesion itself avoids the danger of collateral effects to other parts of the eye. "The rays run parallel to each other in the rod, and are not diffused laterally, so that only such parts are subjected to radio-active effect as are brought into actual contact with the quartz applicator." Gronholm, at the Finsen Institute, treated 98 trachomatous cases with the "Finsen" lamp, of which number 78 were cured and the remainder improved. "There was no spread of the lesion in any of the cases treated. Relapses, however, occurred. In most instances one or two powerful radiations are sufficient to eradicate the follicles at a given spot."

That in ultraviolet an almost specific therapy exists for tuberculous lesions is little doubted by workers who have had adequate experience with this therapy. Here local treatment is important, supplemented by general body irradiations.

While it is appreciated that an overwhelming amount of data is not yet available on the use of ultraviolet in ophthalmic diseases, there is sufficient evidence available to inspire the zealous investigator who is interested in this newer therapy. Recent reports indicate that ethical clinicians are always open-minded to suggestions which may aid present procedures even though the action of these newer aids are nothing more than empirical.

PHYSICAL THERAPY IN THE MODERN HOSPITAL

HOSPITAL STANDARDIZATION REPORT ON PHYSICAL THERAPY

Physical therapy has been found of benefit in such a wide variety of cases, including after-treatment of fractures and traumas, metabolism disorders, mental disorders, and others, that almost every general hospital would find considerable use for a physical therapy department. Hospitals seeking guidance in the organization and management of a modern physical therapy service are advised to observe the following requirements:

1. That hospitals carrying on physical therapy have a well organized department under competent supervision.
2. That the department be properly planned and equipped in accordance with present day standards.
3. That there shall be adequate, trained personnel under competent supervision.
4. That a comprehensive system of records be available in the department and filled in an accessible manner.
5. That a definite procedure be established for the reception, treatment, and discharge of the patient.
6. That as far as possible there be periodic analysis of the work of the department to determine the results.

If the physical therapy department is to achieve clinical results it is imperative that the director be a medical graduate especially trained in physical therapy. Without a medical education and special training in physical therapy he is not capable of judging the type of treatment best suited to the patient's condition nor outlining a prescribed course of treatment that will aid in rehabilitating the patient. Physical therapy is of value only when properly administered and may do harm if given by a person not having a knowledge of anatomy and physiology.

The educational standard for technicians should approach that established by the American Physiotherapy Association. Besides a high school education technicians should have had a course in physical education or in physical therapy conducted by a recognized training school for nurses or accredited school of therapy. Practical experience is also necessary before the student can be called a full-fledged physical therapy technician. Technicians should always work under the supervision of the medical director.

In constructing the physical therapy department a solarium equipped with quartz glass is extremely practical. All rooms should have plenty of light and air and those in which electrical equipment is used should be floored with rubber tile. Insofar as possible all equipment should be made shock-proof. The minimum equipment will probably include ultraviolet and infra-red lamps, gymnasium equipment, diathermic, galvanic and sinusoidal machines, electric bakers, and bathing facilities.

The records to be kept in the department should include a brief summary of the history of the patient with provision diagnosis, description of treatment as to type and quantity, report of progress while under treatment, and finally, a detailed description of conditions of patient on discharge.

Physical therapy has so often been empirical that for a long time it was in disrepute. It is only since noted physicians have turned their attention to its correct administration that its true worth has become widely recognized. Proven methods of treatment which have been shown by authorities to be sound are best adapted to the hospital opening a physical therapy department for the first time. A regular, timed schedule of treatment should be insisted upon. Each patient must be thoroughly examined, and diagnosis confirmed before treatment. No patient should be kept under treatment longer than necessary.

The relative newness of scientifically practiced physical therapy makes accurate records of this specialty doubly valuable. The hospital that endeavors to correlate its records is rendering a genuine service to the progress of medicine, and will be certain to improve the technique used by its own physicians. Notwithstanding all that has been said of the value of physical therapy the limitations of the various forms of treatment must be fully recognized. Physical therapy is not a cure-all and its use must not be overestimated. It is only through proper evaluation of the improvement obtained from this form of therapy and through careful study of end-results that the real worth of this branch of medicine can be established. The future success in the scientific development and use of physical therapy rests on the careful observation of end-results.—(From the *American College of Surgeons, Hospital Standardization Report* for the year 1930.)

PHYSICAL THERAPY CLINICS

AN IMPROVISED DIATHERMY SCALPEL

J. B. H. WARING, M.D.

CINCINNATI, OHIO

No thinking surgeon today will attack a suspected malignant new growth with the ordinarily employed surgical scalpel. How many beautifully executed radical breast amputations have we seen, the axillary glands cleanly dissected, — and then later find metastasis elsewhere. It formerly was considered good surgical practice to excise a portion of an accessible new growth, await the report of the pathologist, and then proceed with more complete excision. Experience has demonstrated that when a malignancy is incised without complete surgical removal, there is a marked stimulus to the tumor growth.

A marked advance was made with development of the so-called "radio-knife" or cutting current. Comparatively few surgeons have high frequency machines which develop this current and only a limited number are familiar with the technic necessary for its correct usage. As a consequence progress along this line has been slow and will doubtless be so for some time.

However, a great many physicians have high frequency machines which are capable of developing currents for coagulation and desiccation. The increasing popularity of extirpating the faucial tonsils by coagulation and desiccation has made a good many physicians surgical-minded. Beginning with desiccation of moles, warts and other superficial lesions physicians have gradually expanded with increased experience into attack of superficial malignancies, tonsils, etc. It is only a question of time until these same physicians will be employing the cutting current when it is correctly indicated.

For physicians with a diathermy machine of sufficient power for coagulation work, a very efficient substitute for the "cutting current" apparatus may be improvised at little additional expense. (Figure 1). No claim for originality is, of course, made. One of the best known and most suitable diathermy electrode handles is that popularized by Dillinger

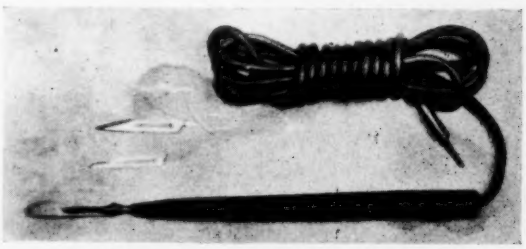


Fig. 1. Improvised high frequency electrode for "cutting."

of Pittsburgh for tonsil coagulation. By taking the metallic handle of a No. 3 style of the widely known Bard-Parker surgical knife and having this filed down into a round stylet of proper diameter and length to fit the Dillinger handle, the blade-holding end of the Bard-Parker just projects beyond the distal insulated end of the holder. With a Bard-Parker blade slipped into place and the electrode properly hooked up to the diathermy machine, we have a surgical scalpel which as it cuts the tissue by actual pressure lays down a layer of coagulation or desiccation below and to either side of the incision. The end result is a bloodless incision similar to that made with the "cutting current" needle.

The stylet can be fashioned in a short time and at very little expense. In coagulation work the active electrode wire terminates in the Dillinger—Bard-Parker knife, while the indifferent terminal is connected to the pad or other suitable electrode for proper contact. Where a desiccation effect is desired, only the one active terminal (Oudin) is employed. Proper current is set as for coagulation work.

The current should give a coagulation trough of about one sixteenth inch with bloodless severing of the tissues. This can be varied at the will of the operator in setting

of the machine. If, after an operation, there is too much slough along the incision line, the milliamperage is reduced. If bleeding is encountered, the work should be slower or the milliamperage increased.

To acquire proper working technic, as in the removal of a breast, localized growths or skin severing, one should practice on a piece of meat until the desired results are attained. For the surgeon, this apparatus is much easier to operate than a "cutting current" apparatus. The surgeon is so accustomed to cut by pressure of the knife blade against the tissues to be severed that it is hard to realize that the "cutting current" needle does not actually cut. The point of the needle must be held slightly above the tissues to be severed, not in actual contact, to make effective the minute arc which actually does the "cutting." With the diathermy knife described above, the surgeon cuts practically as he has always done with the scalpel, except that he employs the tip of the blade rather than its entire cutting edge. Correct technic must be employed to avoid too much tissue destruction along the line of incision.

No attempt is made in this brief article to go into an extensive description of technic. Any surgeon competent in electrosurgery can work this out for himself. It is the purpose here to point out that an effective substitute for the "cutting current" apparatus may be developed with little trouble and practically no expense

WALKING APPARATUS FOR NON-AMBULANT PATIENTS

I. M. LEAVY, M.D.

Director of Physical Therapy, Montefiore Hospital

NEW YORK

The presentation of this ambulant apparatus (Ambulator) was prompted by the request of many professional visitors and physical therapy administrators to our department. The desire to assist patients who have been chair-ridden and bed-ridden has been a most important question in many institutions, and the possibilities of rehabilitating patients in the use of their lower extremities can often be only ascertained by some form of apparatus which will permit them to extend their legs and thighs in the erect position.

There are great difficulties to be surmounted in restoring the functional use of their lower limbs to patients who have been confined to bed for many months, or in those who have reached the ultimate stage of propulsion in a wheel chair. Such patients have not only lost their confidence to walk, wholly or partially, but present the greatest timidity when an attempt is begun to have them perform the rudiments of standing. The lower extremities, which combine a two-fold purpose of propulsion and bearing body weight, we have this latter phase particularly to consider in the restoration of function.

These patients also, to a more or less degree, lose the proper balancing of the body when erect, and elementary instruction must be given to help overcome this handicap.

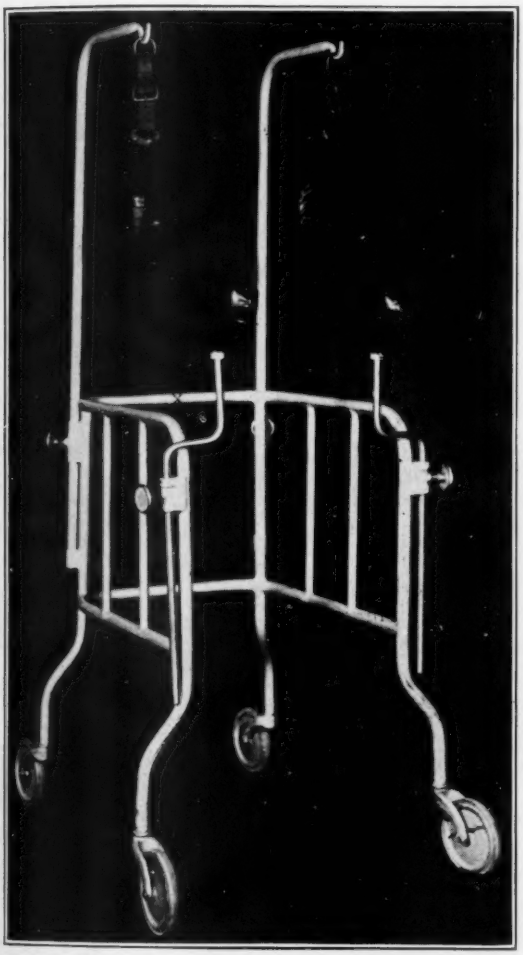
Because of circulatory changes and corresponding reaction of all tissue, due to the altered position, patients are alarmed and become timid by the initial effects. These conditions are especially manifested in patients who have had a lower extremity amputation. In the convalescent, chronic and in many subacute cases that are able to sit in or use a wheel chair, there are practically very few contraindications in the use of this ambulant apparatus. In acute infection, febrile disease and the total permanent paralysis of either both upper or both lower extremities, this form of therapy cannot, and should not, be attempted, for obvious reasons.

The procedure is simple, yet should be carried out patiently. The patient is advised that there is no danger of falling, and instructed to grasp the upright or horizontal bars while standing, and to use whatever voluntary power he has in aiding him to hold himself in the upright position in the apparatus. The two suspension arm rests are placed under the axillae and adjusted to the proper height of the patient by the straps attached thereto. This will permit the patient to be suspended, though there be no support by the lower extremities. It matters not whether, in a spastic condition, the limbs are drawn up, or in a flaccid paralysis, when they may drag, the suspension will tend to hold the body upright

and allow the free use of the limbs by the patient.

At the first sign of dizziness, the patient can be replaced in his chair. Several attempts may be necessary to accustom the patient to the upright position, after which he is instructed to voluntarily flex and extend the limbs alternately while in the standing position.

Fig. 1

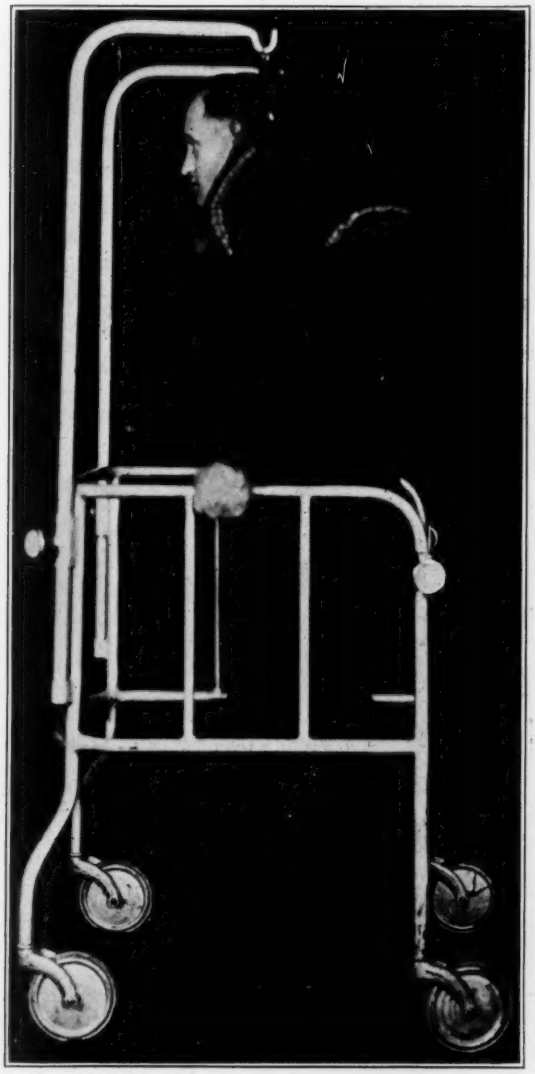


Ambulant Apparatus With the Use of Suspension Arm Rests

The patient, in due time, is instructed in the act of walking, without necessarily moving the apparatus; following which, the attendant standing in front of the apparatus draws it forward as the patient raises first one foot and then the other in his forward movement. These instructions are carried out slowly and gradually, with rest periods at each session to avoid undue exertion, fatigue or exertion, at the first sign of which the exercise is discontinued.

After the patient has progressed without difficulty in walking in the moving apparatus with suspensory supports, he is then transferred to the crutch arm rests, which allow greater freedom of motion for the patient, yet keep him in perfect balance and support with-

Fig. 2



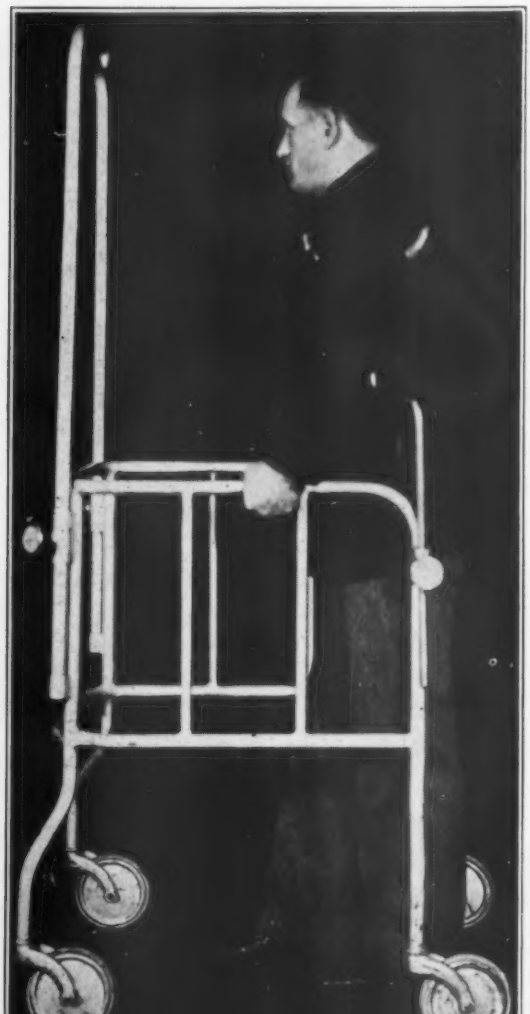
Ambulant Apparatus With Use of Crutch Arm Rests

out danger of falling. As in the suspension, the crutch fits under the axillae, and the patient aids in his movement by holding the upright or horizontal bars with his hands. This manner of exercise is carried out until the patient has obtained full confidence in his ability to move about, in his own way, without fear of falling, and is soon prepared to use a pair of his own crutches to continue further in his exercise of walking.

It is customary later, when possible, to have

the patient change one crutch for a cane, and then discard the use of crutches for canes exclusively, thus reaching the stage where the patient may be self-supporting on his lower extremities in the power of supporting the body and propulsion.

Fig. 3



Ambulant Apparatus Complete With Removable Suspension Arm and Crutch Arm Rests

The suspension differs from the crutch in that the patient's body is held in position without its weight bearing on the lower extremities, and the feet may be permitted to rest on the floor or move freely about. The suspension arm-rests will not slip from under the patient's arms—they will prevent the patient from falling, though there be no actual support by the lower extremities.

The crutch arrangement requires some actual use of the lower extremities of the patient to support or propel himself.

During the course of rehabilitation in walking, the first object is to restore the patient's confidence, and relieve the weight of the body from the lower extremities by the suspensory arrangement. When this is fairly well established, the act of walking and bearing the body weight is performed by the use of the crutch arrangement which prepares the patient for his own portable crutches, and later, to the elimination of any support. Advancing from one stage to another is naturally dependent upon the patient's condition — whether temporary or permanent disability; for in the former, the act of standing and walking will be materially hastened, and in the latter, permit the patient to be at least partially ambulant. As an adjuvant, the ambulant apparatus will offer the proper active exercise, avoid atrophy, and increase circulation and nutrition to the dependent extremities.

Technical Description: Frame, constructed of 1 in. pipe, is 20 in. wide by 24 in. long. The frame is made up of two "U" shaped horizontal bars, 16 in. apart, parallel to each other and oxy-acetylene welded to four legs, curved outwards at the bottom to prevent tipping. Two vertical fillers, ½ in. pipe on each side, oxy-acteylene welded to "U" shaped bars. The two front legs are equipped with two lugs each, bolted to legs to receive two upright davits, constructed of 1 in. pipe, 54 in. high. Davits are adjustable in height, and position by means of hand wheel. The davit ends have hooks for hanging suspension arm rests. The suspension arms rests are elonged "C" shaped, solid iron, covered with felt and leather and suspended at one end by adjustable straps. These arm rests are readily removable. The two legs at the rear end (entrance) are equipped with one lug each, bolted to legs to receive ½ in. nickel plated rods, bent at right rangles at the middle and equipped with crutch arm rests, covered with felt and leather. Crutch arm rests are adjustable in height and position by means of hand wheels, and are also easily removable. Apparatus is mounted on four 6 in. rubber tired wheels, two at the front end are swivel and two at the rear end (entrance) which are stationary.

QUESTIONS AND ANSWERS

Q. What is the value of massage as a therapeutic aid in sprains?

A. No better answer to this timely question is the discussion of the subject of massage by Coulter, Pemberton and Mock. (*J. A. M. A.*, 94:1933, June 21, 1930.) The part on massage in sprains is quoted in full because it completely answers the foregoing query.

"The best treatment for sprains is frequently given by trainers for various athletic teams. Physicians generally could learn from these trainers many important points in the technic of the treatment of recent injuries. These trainers are paid to keep men in the game and to get them back quickly if they are injured. The excellent results obtained are due to the trainers' willingness to take time to treat minor injuries and the fact that the patients have the time to devote to the care of an injury that in business is usually not thought serious enough to justify the effort required for proper treatment.

"As physicians we often have all these factors present, but we are so accustomed to treat sprains and strains by immobilization and rest that we neglect the use of proper massage, bandaging and mobilization.

"Mennell expressed the keynote of the treatment of recent injuries when he said that we cannot heal torn fibers by massage but can assist in restoring the circulation on which depends the repair not only of these fibers but of all the various injuries that have been sustained.

"Accompanying a sprain there are often torn ligaments, a tenosynovitis and a traumatic arthritis. There is hemorrhage from the torn vessels. There is muscular spasm and this, with the local swelling, interferes with the venous circulation. But often there is swelling both above and below the joint which the local conditions could not cause. This is undoubtedly due to a reflex disturbance of the vasomotor mechanism from injury to the nerves.

"Therefore the kind of massage at first used is superficial stroking with the whole limb in a position to relax all the muscles and to take advantage of gravity. This massage aims to restore vasomotor tone to prevent further effusion. This is aided between treatments by proper compression—bandaging or strapping. Later, deep stroking massage and kneading may be used to secure diffusion of the exudate at the site of the injury.

"For instance, in the treatment of a severely sprained ankle, the ankle is often tightly strapped and the patient sent home with directions to rest and apply some form of heat. Far better results as to the relief of pain and the restoration of function could be secured if the patient were treated as follows:

"The first day the bandage or strapping is removed and, with the patient lying on a couch with a pillow under the knee and some support to keep the foot straight, heat is applied in some form, either direct diathermy or radiant heat, for twenty minutes. Then superficial stroking massage is begun over the whole foot and leg, the movement being started at the upper border of the swelling. Deep stroking follows this above and below the ankle, the painful area being gradually approached. The massage is continued for twenty minutes. This is followed by knee and toe motions. The bandage or strapping is reapplied.

"If possible, this treatment is given twice on the first and second days, and once on the third day.

"The fourth day deep stroking massage, kneading and friction massage are given as on the first day, also relaxed movements of plantar and dorsal flexion of the ankle to the point of pain. The massage should be given over the injured area if there is no pain. Any motion should be limited by the onset of pain. The foot should always be supported when massage or motion is given so as to prevent any further strain of the injured ligaments.

"The fifth day the massage is increased over the injured area, and ankle motion is increased. If strapping or a bandage is correctly applied and the pain and swelling are not severe, walking may be started.

"The support of the bandage or strapping

is gradually decreased, the firmness of massage is increased and walking is gradually allowed."

Q. Is the roentgen ray treatment of lymphoid hypertrophy of Waldeyer's ring considered rational? What is the present status of irradiation for this condition?

A. In this country the x-ray treatment of tonsils and adenoids is in a reactive stage. Rhinologists agree that there are definite indications for non-surgical methods. Roentgenologists recognize that inoperable cases can be managed by radiation. There are positive and negative arguments for roentgenotherapy and the physician should listen to both with an open mind. No single procedure, surgical or non-surgical is suitable as a routine. Careful analysis of the case and scientific evaluation of the method to meet existing indications are at all times necessary when finally advising the treatment. A recent reference in point is an article by Schoenfeld and Baumbach (*Strahlenther., 1930, Bd. 36, H. 3,* (March), p. 472). This article was abstracted in the Dec. (1930) issue of the ARCHIVES, p. 693. The reader is referred to the English abstract for details given by the authors who give statistics of a series of cases recently under their care and observation.

Q. What is the present status of radiotherapy in Basedow's disease?

A. The overenthusiasm of radiotherapy of Basedow's disease has gradually waned with a better understanding of the disease itself. There are, however, numerous clinicians who still adhere to this treatment in preference to surgery and are able to cite from their experiences successful results to substantiate their claims. Cramer (*Zeitschrift fur Arzliche Fortbildung, 27*:392, June 15, 1930), directs attention to the fact that recent improvements in technic have made the treatment by röentgen rays and radium more efficacious. He contends that all forms of thyroid diseases are favorably influenced by irradiation and are particularly of advantage as a prophylactic means. Contraindications consist of the presence of associated or coexisting diseases. Dosage is the prime consideration. Frequency of irradiations is also to be carefully judged. In the author's experience, distribution of treatments over a period of time gives the best results. When polyglandular insufficiency exists irradiation had best not be employed. While improvement and cure is known to occur by radiotherapy, Cramer is emphatic in the assertion that this means of managing Basedow's disease has not been finally settled.

Q. Is fibrositis amenable to physical treatment?

A. This is an ever important subject. That physical methods have aided greatly in the management of fibrositis is little disputed. The consideration which influences good results is correct technic, and when this is employed, favorable action usually follows. An excellent treatise on the physical treatment of fibrositis by Gordon (*B. J. of A. and P.*, 5: 90, Aug. 1930), was abstracted in *Physical Therapeutics,* Oct. 1930, and is here given *verbatim*:

"Fibrositis is defined as a reaction of the fibrous tissues to circulating toxins of various types in those who are predisposed to such a reaction. The result may be an acute or a chronic condition. In the acute form there is a point of irritation leading to an intense local muscular spasm. In the chronic form there results the formation of a nodule, the absence of which should eliminate a diagnoses of fibrositis. The nodule is a round, oval, or longitudinal mass of avascular tissue with a lack of elasticity and a tendency to contract. It may or may not be tender and will be felt upon palpating relaxed muscles or fibrous structures. These nodules are the result of tissue reaction to circulating toxins, either exogenous or endogenous. They are found in fascia and intermuscular trabeculae, giving rise to muscular rheumatism, in sheaths of peripheral nerves, or in the capsules of joints, often causing deformity.

"The treatment recommended is divided into four parts: (1) the relief of the acute symptoms, accomplished by immobilization and the use of radiant heat or diathermy; (2) removal of the underlying causes; teeth, tonsils, gall bladder, appendix, colon, digestive organs should be carefully examined for possible local foci of infection and the appropriate treatment instituted: general metabolism may be improved by the use of hot baths, radiant heat, or diathermy or by protein shock: increase elimination by the use of laxatives and

copious draughts of water; (3) the removal of the nodule is effected in one of two ways; either by increasing the local circulation by means of heat, diathermy, and ionization; or by proper massage; (4) recurrences must be prevented by proper care and treatment."

Q. What are some recent developments concerning actinotherapy treatment of tuberculosis?

A. There has been expressed varied opinions on the use of actinic radiation in tuberculosis. At present a wide diversity of opinion exists and rules are laid down which have been based on theoretic grounds rather than on clinical experience. Little question is raised as to the value of ultraviolet in extrapulmonary tuberculosis. The value of the rays in pulmonary disease is still debatable. The fact that actinotherapy differs in clinical effect in various locations must also be considered. Dufestel, (*Bulletin Medical,* 44:375, May 24, 1930. Abstract *Physical Therapeutics,* Oct. 1930), reports on his experiences with actinotherapy of tuberculosis in various locations, the abstract of his original articles following:

"The gratifying results obtained in the treatment of surgical tuberculosis by means of heliotherapy raised a lively hope of curing these affections likewise with the ultraviolet rays, the most active and least calorific portion of the solar spectrum. This hope has not been fully realized in practice, and the forms of surgical tuberculosis may be roughly divided into two categories—those responsive to actinotherapy and generally benefited by ultraviolet irradiation, and those which are actinoresistant. Nevertheless it may be said in a general way that ultraviolet therapy ought always to be tried in every localization of surgical tuberculosis. It has always the effect of a general tonic and extensive irradiation of the body surface greatly favors the means of defense of the organism against infection. This markedly enhances the effect of local irradiation through its hyperemic activity in reactivating tissue vitality.

"The actinosensitive type of tuberculous lesion is represented by certain forms of subcutaneous tuberculous adenitis, particularly when there is much swelling, when soft or fistulous. In such cases the ultraviolet rays tend to a rapid healing, while they prove ineffective in less voluminous adenopathies and where there is no periadenitis. Their use is especially indicated in tuberculous peritonitis. Most osseous and articular localizations the author has found actinoresistant, but here systemic irradiation may contribute to local improvement. Epididymotesticular tuberculosis is actinoresistive, and that of the adnexa still more so. Tuberculous enteritis occurring in the victims of pulmonary tuberculosis is not usually influenced by the ultraviolet rays. In tuberculous hipjoint disease actinotherapy may be applied either to diminish spasms or for its effect on the peritoneum or on adenopathy. Tuberculous fistulae benefit greatly by extensive treatment: local treatment must be carefully administered in order to avoid closing the external opening in spite of discharge not having yet ceased."

Q. Is radium being employed in the treatment of hemangioma of larynx?

A. The subject of hemangioma of the larynx is reviewed by Simpson (*J. A. M. A.,* 96:342, Jan. 31, 1931), who calls attention to the fact that this is a rare disease. Simpson advocates radium treatment and writes:

"Operative measures, especially cutting operations, are contraindicated in the larger laryngeal hemangiomas on account of the danger of hemorrhage. Sweetser states that radium treatment is the only safe method of treatment. Experience with the radium treatment of hemangiomas of the larynx has not been large. On account of the favorable effect of radium in hemangiomas elsewhere, Ryerson of Toronto was led to use radium in 1912 in a case of laryngeal hemangioma. He applied a small radium plaque intralaryngeally to the surface of the growth. Clinical recovery followed.

"In 1919, New and Clark reported three cases in which improvement followed the use of radium externally over the larynx. Theoretically, radium may be applied to the laryngeal hemangioma by (*a*) surface applications to the skin over the larynx, (*b*) intralaryngeal applications to the surface of the tumor, and (*c*) the intralaryngeal insertion of radium or radon ampules or needles into the tumor. The last named method had not yet been used to my knowledge and in fact I doubt its advisability."

CURRENT NEWS AND COMMENT

Seminar Conducted Under Auspices of Physical Therapy Society in New York

This seminar consisting of didactic lectures and clinical demonstrations is designed to give a comprehensive outline of physical therapy to the practitioner particularly interested in the subject.

The classes will cover a period of four months, February, March, April and May. The opening meeting of each month will be held in the evening and start at 8:30, the subsequent meetings in the afternoon from 3:30 to 5:00.

Applications are now being received by Dr. M. C. L. McGuinness, Secretary of the New York Physical Therapy Society, 3 East 85th Street, New York City.

A charge of $25.00 will be made for this seminar (including both the didactic lectures and clinical demonstrations). Single lectures, $1.00.

The schedule is as follows:

February 4th—Clinical uses of Ultraviolet Radiation—Dr. Edgar Mayer, Saranac Lake, N. Y.

11th—Physics of Ultraviolet Radiation — Dr. E. E. Free, Special Lecturer in General Science, N. Y. University.

18th—Physics of Photo and Heat Therapy —Dr. E. E. Free.

25th—Physiology of Ultraviolet Radiation —Dr. George H. Maughan, Dept. of Physiology, Cornell University and The Effect of Ultraviolet in Cutaneous Conditions—Dr. George M. MacKee, Prof. and Director of the Dept. of Dermatology and Syphilology, N. Y. Post Graduate Medical School and Hospital, Member of Council on Physical Therapy of A. M. A., New York.

March 4th—Massage—Dr. Ralph Pemberton, Physician to Presbyterian Hospital, Philadelphia, Associate Prof. of Medicine in the Graduate School of the University of Pa.

11th—Physics of Medical Electricity—H. J. Holmquest, B.S., M.E., formerly Secretary of Council on Physical Therapy of A. M. A., Chicago.

18th—Electro-Static Therapy—Dr. William D. McFee, Director, Dept. of Physical Therapy, Boston City Hospital, Boston.

25th—Low Voltage Currents—Dr. Frank H. Krusen, Director, Dept. of Physical Therapy of Samaritan Hospital and Associate Dean of Temple University, Philadelphia.

April 1st—Physical Therapy in Fractures—Dr. Clay Ray Murray, Assistant Prof. of Surgery, College of Physicians and Surgeons, Columbia University.

8th—Medical Diathermy—Dr. Harry Eaton Stewart, Director, New Haven School of Physical Therapy, New Haven, Conn.

15th — Surgical Diathermy — Dr. William Schmidt, St. Mary's Hospital, Philadelphia, Pa.

22nd—Hydrotherapy—Dr. Joseph B. Nylin, Chief of Clinic Dept. of Physical Therapy, University of Pa., Prof. in Physical Therapy, Women's Medical College, Philadelphia, Pa.

29th—Physical Therapy in Urology—Dr. F. G. Harrison, Associate Prof. of Urology, Graduate School of Medicine University of Pa., Associate G. U. Surgeon, Presbyterian Hospital, Philadelphia, Pa.

May 6th—Indications and Contraindications of X-Ray Radiation — Dr. Francis Carter Wood, St. Luke's Hospital, N. Y., and Treatment of Cutaneous Cancer and Pre-cancerous Lesions—Dr. George Millar MacKee.

13th—Physical Therapy in Orthopedics — Dr. Walter I. Galland, Assistant Orthopedist, Joint Diseases and Lenox Hill Hospitals.

20th—Physical Therapy in Gynaecology — Dr. Grant E. Ward, Baltimore.

27th—Posture as a therapeutic procedure—Dr. Royal Storr Haynes, N. Y., and Posture and Exercise in Adults—Dr. K. G. Hamsson, Director of Physical Therapy Dept., Hospital of Ruptured and Crippled, New York.

There will also be clinical demonstrations of cases and of technic in the physical therapy departments of the following hospitals:

Bellevue — Beth Israel—Hospital for Joint Diseases—Montefiore—Mount Sinai—Presbyterian — Reconstruction (Unit of the N. Y. Post Grad. Med. School and Hospital) — Ruptured and Crippled Hospital.

Suggested Principles Applying to Industrial Medicine

As a result of several recent instances of misunderstanding among industrial surgeons and between industrial surgeons and physicians in general practice, the Industrial Relations Committee and the Ethics Committee of the Wayne County (Detroit, Michigan), Medical Society made a study of the industrial medicine situation and has drafted the following tentative set of principles, with the suggestion that they be subscribed to by all physicians doing industrial surgery in Wayne County:

1. An industrial surgeon should consider his relations with the factory which he serves in the same manner as a physician called to attend a family in general practice.
2. He should in no way solicit business from or advertise himself to any industrial plant unless he positively knows that the plant in question is not being cared for by any other surgeon.
3. He should refuse appointment as surgeon by an industrial concern or insurance company concerned in the transaction until he is sure that the factory has no regular surgeon, that the surgeon has resigned, or has been officially discharged.
4. If necessary, he shall acquaint himself of the actual facts of the case by first calling upon the surgeon himself for a statement before entering into any negotiations whatever to take over new work.
5. He shall refuse to go in attendance to any factory which is regularly under the supervision of another doctor, except in emergency.
6. He shall under no conditions discuss rates or fees to any factory or insurance company, either in person or by letter, if this factory is being regularly cared for by another doctor.
7. Any infringement of these rules shall be construed as an unfriendly act and shall be referred to the Ethics Committee of the Wayne County Medical Society for decision.
8. The industrial surgeon should in every way possible raise the standing of this branch of the profession by:—

(a) Personally supervising as much as possible the care of patients at office and factory.

(b) Preserving a sufficiently high standard of fees paid by insurance companies to insure skillful and painstaking service.

(c) Fostering a relationship of mutual respect and trust, not only between the industrial surgeon and his employers, but an ethical relationship with other industrial surgeons.

Harnes (*J. Exper. Med.*, 1930, 52, 253) found that normal rabbits living in total darkness and exposed to ultraviolet radiation at regular intervals showed a more rapid rate of increase in weight than animals living under the same condition, but after an initial period of rapid increase the irradiated animals maintained a lower body weight than those living in the dark. Under the same conditions animals inoculated with *T. pallidum* and exposed to ultraviolet light maintained a lower weight than the corresponding control groups living in total darkness. Furthermore, the mortality rate from pneumonic infection was found to be greater in animals exposed to ultraviolet radiation than in those living entirely in the dark. It is evident, therefore, that, under the conditions given, ultraviolet radiation was detrimental rather than beneficial.

Chapman and Hardy (*Am. J. Hyg.*, 1930, 11,404) have carried out studies in the hope of obtaining some experimental evidence of the effect of ultraviolet radiation on resistance to infection. With the exception of one case, all the evidence collected goes to show that local radiation, in light, moderate, or heavy doses, single or repeated daily for two weeks, has no effect in preventing or mitigating the lesions produced by subcutaneous implantation of Bacillus lepisepticum. It is possible that the effect of the ultraviolet light, which is known to penetrate the skin very slightly, may be less marked on an organism introduced subcutaneously than on one which must make its own way through the skin, or parasitize the cells of the skin itself. Also, it is conceivable that better results might be obtained by using smaller doses of bacteria, but it was desired to eliminate the element of chance. Radiation, with just the right timing and dosage, may have some effect in turning the balance in favor of resistance, but this result is indeed difficult to attain. The conclusion drawn from these experiments, if any is justified, is that local radiation in light doses does not enhance the resistance of rabbits to subcutaneous infection with Bacillus lepisepticum, and that, in very heavy doses, it may be harmful.

THE STUDENT'S LIBRARY

BOOK REVIEWS

THE ELEMENTS OF MEDICAL HIGH FREQUENCY AND DIATHERMY. FOR ASSISTANTS AND NURSES. By *W. Claughton Douglass,* M.C., M.R.C.S., D.M.R.E.. Medical Director, Comely Bank Electrotherapeutic Clinic, Walthamstow; Clinical Assistant, X-ray and Electrotherapeutic Departments, St. Bartholomew's Hospital, etc.; Examiner in Electrotherapeutics to the Chartered Society of Massage and Medical Gymnastics. With 67 illustrations. London. H. K. Lewis & Co., Ltd. 1930.

This is a small work which has been prepared especially for the use of nurses and assisants in electrotherapy. As the author has limited the detail of the principles and technic he urges that those students who have mastered the elements, as set forth in this book, supplement the knowledge so gained by reading one or another of the standard treatises.

There are thirteen chapters in all, commencing with a consideration of the alternating current and concluding with the treatment by the diathermy current. A subject which is not generally understood, that of the production of alternating currents is discussed in chapter two. The diagrams are helpful in explaining some of the basic physical principles. Electromagnetic induction is likewise treated in a simple explanatory fashion.

The heating effects of electric currents is reviewed in chapter seven, following which the D'Arsonval high frequency apparatus is described. The subject of diathermy is considered in its various divisions, the production of the currents, application, and methods of treatment in diseases in which such treatment is indicated. This latter section is necessarily brief, but probably too much so. After all the nurse or assistant is primarily interested in the practical side of electrotherapeutics and seeks information which he or she can employ in everyday work.

It may be said, however, that the book fulfills a definite need. It can be perused and studied to advantage by the nurse whose time is necessarily limited and whose preliminary education in physics is not advanced sufficiently for her to comprehend the detail of larger treatises on electrotherapy.

THE ATOM. By *J. P. Thomson,* M.A., Professor of Natural Philosophy, University of Aberdeen. Pp. 252 with illustrations. Price, $1.25. New York. Henry Holt & Co. 1930.

A subject so intricately complex as the very alluring atom is difficult to present in an untechnical, ordinary language. Indeed, there is nothing ordinary about the structure and the behavior of the atom; and a discussion of these must necessarily touch most every phase of mathematical and scientific inquiry.

In this admirable book the author has turned the spectroscope on the atom, just as the astronomer turns the telescope on the universe. If a vision of the universe in the telescope is bewildering, much more intriguing and astounding is the vision of the atom in the spectroscope. Having explored the atom through the spectroscope, in rapid succession the author describes briefly, but with unusual clearness, the components of the atom. The proton and the electron are exposed. The size and the weight of the atom is determined and measured; and then, finding wavelengths of light so tiny that the rulings on a glass plate are incapable of resolving the radiation, the author quickly points out how natural crystals, owing to the orderly arrangement of atoms which compose them, served the great Laue as a defraction grating capable of resolving the x-ray.

Radio-activity is briefly reviewed and its multiple effects disclosed.

An especially interesting chapter is the one devoted to the units of energy. Here in a few succinct sentences the author makes clear the concept of "quanta,"—a concept which was difficult even for physicists to visualize and accept and which is not easy to explain even were technical language permitted. The nucleus of the atom is next investigated, and then the energy levels. This is followed by a discussion of the wave theory of matter, in which all of the important developments of the past decade are briefly but clearly reviewed.

The meaning of electrons to the chemist is a subject separately discussed in the next to the last chapter; and finally, the author finishes this instructive work with some general conclusions. It is difficult to realize that so materialistic a concept as that of matter and energy might influence philosophical thought; but Thomson neatly points out how the recent "quantum mechanics" strongly lures philosophy away from the doctrine of determinism.

Not the least value of this splendid review is the full and critically assorted bibliography which permits the interested student to pursue whatever aspect of the atomic theory he may be most interested in with an assurance of accuracy of statement and authority of fact.

By no means is this remarkable book a "popular science" compend. Its facts are as exact as present knowledge permits us to accept but they are presented so lucidly and lucently as to make them acceptable to anyone displaying even everyday knowledge in this magic branch of physical science.

A physical therapist using the energies around which this book is written has the opportunity of reviewing in an hour of enjoyable reading one of the most excellent summaries of the new wave theory of mechanics and atomic structure that has so far presented itself to the editor's desk; and the physiotherapist who is not acquainted with the contents of this book is not faithful to the study of the energies which he directs for the betterment of physical well being.

THE STORY OF SAN MICHELE. By *Axel Munthe* with New Preface by the Author for the American Edition. Cloth. Price, $3.75. Pp. 530. New York: E. P. Dutton & Co., Inc. 1930.

In spite of the author's affirmation that his book was neither written for autobiographical purposes or intended as a "Memoir" the contents of the book as well as the style vividly carries this suggestion. It is certain that Dr. Munthe has liberally borrowed from personal experiences and from an imagination that has been richly endowed. The book is an autobiographical story of a Swedish physcian who reaches the heights of a successful practice among the élite of Paris and Rome, but who has never neglected every opportunity to offer his services to the unfortunate and the poor. It is a story in which poverty and riches, pathos and rollicking humor is taken from the crucible of experience and retold in a manner so fascinating that seldom is the book relinquished until the last word has been read. It leaves impressions of "sweet sorrow," for throughout the pages of this chronicle Death hovers near, and His sweeping progress is delayed only to return in the end. It contains many episodes that are gruesome, sensational, pathetic and farcical. A reviewer has remarked that "there is enough material in 'The Story of San Michele' to furnish writers of short sensational stories with plots for the rest of their lives." In answer to this, the author has quite generously declared, "They are quite welcome to this material for what it is worth. I have no further use for it. Having concentrated my literary effort during a lifetime on writing prescriptions, I am not likely to try my hand on short sensatonal stories so late in the day."

There is a rich undercurrent of humaneness for lower forms of life, tolerance for misguided humanity and pity for all unfortunate sufferers. The love for animals has been one of the motiviating forces that has influenced him throughout life. His philosophy is reflected by his answer to one of his patients in regard to his attitude toward life. "I know that life is beautiful, but I also know that we often make a mess of it and turn it into a silly farce or a heartrending tragedy, or both, so much so that one ends by not knowing whether to cry or to laugh. It is easier to cry, but far better to laugh, so long as one doesn't laugh aloud."

The description of his experiences in Naples during one of the cholera epidemics is one of the finest pieces of vivid descriptive writing of modern times. One actually is gripped in the horror of chaos and filth and pathos of a situation that got out of the control of the vested authorities and was taken over by the local church and the medical profession. Death took its toll in both of the foregoing ranks because of exposure and overwork. We shall not offer any abbreviated excerpts from this episode for fear of not doing it the complete justice it deserves. Needless to say it is a remarkable piece of descriptive writing and should be read to be fully appreciated.

The theme of this chronicle is not the telling of horror stories; neither has it been partial to sentimentalism. It is the story of the rich experiences of a broadminded and kindly physician who relates the many adventures that fell to his lot, who describes his reactions in such glowing colors that vicariously we become participants in all of his varied experiences. This is the very height of literary artistry. That the book has already reached the twenty-eighth reprinting is an index of its remarkable popularity. This book should be in the hands of all physicians.

ASTHMA AND ITS TREATMENT. By *Percy Hall,* M.R.C.S. (Eng.), L.R.C.P. (Lond.). Late Hon. Actinotherapist, The Mount Vernon Hospital, London and Northwood, etc., etc. 130 Pp. London. William Heinemann (Medical Books), Ltd. 1930.

This little book is merely the attempt of a practicing clinician, who has found he could place little reliance upon drugs, to show how the "more modern" natural therapeutic modes can—if used with care and discretion—bring relief to sufferers who otherwise would seem mostly to seek relief in vain.

There are two distinct sections, the first a brief one on causes and symptoms, the second, more comprehensive, on treatment. In the first section are considered the manifestations of asthma, its etiology, symptoms and signs. In part two, under treatment such subjects are discussed as general hygiene, surgery, vaccines, drugs, diet, diathermy and actinotherapy. Hay fever comes in for brief consideration after which numerous case reports are cited.

The author is fair in his general analysis of the subject of asthma and appears to have a rational understanding of its various aspects. While it can be argued that no one system of therapy has ever been successful in this affection and that because of this it is radical to advocate a single remedy such as ultraviolet, it should be noted that the author gives due attention to such etiological factors which coexist with the main symptom. A good deal of reliance is placed on the use of diathermy as an aid, although the method of technic as suggested would prove more than controversial.

Those who have employed ultraviolet irradiation empirically for the treatment of asthma in children are staunch enthusiasts of the method. Good results with this therapy have also been reported in adults. It must be admitted, however, that they have not been as uniformly successful as the author's. No doubt the technic is an important factor and this is stressed. The indifference to correct application and dosage accounts for poor results in many instances.

After all is said and done, the correct diagnosis is of paramount value. The etiology should be ascertained, if at all possible. The rhinologic aspect is not always thoroughly investigated. Here a contributing cause of much significance is frequently found. When every likely cause has been determined and treated either by removal or correction, and empiric therapy seems justifiable, ultraviolet is the remedy of choice. It may not always effect a cure, but usually affords a degree of improvement to make its continued use rational. In this connection the author differs in that he contends that the method cannot any longer be referred to as purely empirical. His argument is that any procedure which produces favorable results which can be duplicated and reduplicated ceases to be an em-

pirical remedy since experience absolves it from such designation.

There is more written in these few pages than their number would lead one to believe. One must, however, be qualified to read between the lines.

CLINICAL ALLERGY PARTICULARLY ASTHMA AND HAY FEVER. MECHANISM AND TREATMENT. By *Francis M. Rackemann,* M.D. Physician to the Massachusetts General Hospital; Instructor in Medicine, Harvard Medical School, Boston, Mass. 617 pp. Price, $10.50. New York. The Macmillan Company. 1931.

Interest in allergy is constantly increasing. While usually associated with hay fever and asthma, manifestations of hypersensitiveness are now no longer restricted to these affections. Practically every specialty in medicine and surgery must at some time or another deal with allergic symptoms of a disease in its field. Primarily, however, on account of their prevalence, hay fever and asthma are particularly considered as allergic problems.

This book is unquestionably the most comprehensive compilation which has thus far been published. In addition to an exhaustive review of the literature it includes reports of the author's wide experience with this comparatively new sicence.

The question of terminology in a work of this nature is adequately explained in the introduction: "It would be desirable to indicate this phenomenon of hypersensitiveness by a single word, but the present terminology is somewhat confused." The bibliography at the conclusion of each section, even the introduction, at once demonstrates the completeness of the preparation of this book. It also instills a confidence that the statements made which are not the author's, are quoted from authentic sources which can readily be referred to.

In the first part of the book the phenomenon of hypersensitiveness is considered. Nine chapters include a discussion of the fundamental aspects, but emphasize particularly the chemistry of hypersensitiveness, immunology of hypersensitiveness, and desensitization. Bacterial allergy, the nature and origin of allergy and the diagnosis of hypersensitiveness are adequately and elaborately treated.

Part II concerns itself with the clinical manifestations of allergy. This part is thus handled as a distinct book in itself. In it are reviewed and discussed the various phases of hay fever and asthma. Specific desensitization occupies fifty pages of material while clinical types of asthmatic patients likewise comes in for an extensive writing. Aside from hay fever and asthma, such diseases as urticaria, erythema multiforme, angioneurotic edema, eczema, migraine, etc., are analyzed from their allergic aspects. Thirty illustrations are listed.

One can justly say that this volume represents a life's work. The reviewer is thoroughly familiar with the literature on allergy by having closely followed the subject for more than fifteen years. Every attempt to find a familiar or obscure reference in the complete bibliographies was successful. One must therefore appreciate the painstaking efforts on the part of the author as nothing worth while has appeared in the medical literature on allergy which is not reviewed, analyzed, quoted or discussed.

The reviewer's critical eye has caught at least one misquotation. Evidently the original article was not carefully scrutinized. There appear also a few misspellings of author's names. Both of these criticisms are of minor moment and errors such as these readily creep into a first edition of any book.

Whether the physician has become a convert to the school of allergy, or not, Rackemann's "Clinical Allergy" belongs in his library. Information on a single point pertaining to any of the allergic diseases, and which is sure to be found in this volume, will more than compensate for the very moderate price of this very excellent and exhaustive work.

HAEMODYNAMICS. The Mechanism of Venous Capillary and Lymphatic Flow; and Injection Treatment of Varicose Veins by *P. B. Kittel,* F.R.C.S., Assistant Surgical Officer at the Royal Northern Hospital, London. Pp. 195 with three plates and seven figures. Cloth. Price 10-net London: H. K. Lewis & Co., Ltd., publishers, 1929.

This small volume deals with original studies on the pathological weaknesses of the venous circulatory apparatus. Special emphasis is devoted to that portion of the anatomy related to the formation of varicosities and circulatory disturbances of the extremities and their treatment by the injection method. The book contains twelve chapters and is roughly divided into an exposition of the anatomico-circulatory abberations of these parts and an account of the author's experiences a series "of over 400 cases with various sorts of material designed by trial to be efficacious for the cure of varicose veins when applied by the operation of injection." Studies were carried out with various drugs such as quinine urethane, sodium salicylate, saline borocane, glucose, and sodium morrhuate. The latter drug is a new innovation in varicose injection therapy and is described with its merits and defects and compared with the other drugs mentioned above. Its superiority over all the other preparations is summed up by the author in the following manner: "I have reduced the reasons to a list which I hope are fairly set out, for thinking this new treatment has advantages over older methods: 1. It is safe to life. 2. It is simple. 3. It is done without lying up. 4. It causes no permanent scars. 5. It can be repeated without conditions. 6. It is successful, save in a few cases, which are relieved. 7. It treats veins in the presence of their physical signs. 8. It is safe from danger of chemical ulcer if morrhuate is used."

One closes the pages of this volume with an impression that the author has in a scholarly manner pointed out a new therapeutic procedure and that he has contributed some interesting experiences toward the practice of injection therapy in varicose veins. This book should have a particular appeal to the general practitioner for it suggests a method of treating varicosities of the extremities without some of the unpleasant accidents that have heretofore been experienced with the injection method.

INTERNATIONAL ABSTRACTS

Acute Nephritis — Diathermy. Prof. H. Eppinger.

Med. Univ. Clinic, Fribourg i. Br. Klinische Wochenschrift, No. 44 (1930).

In acute nephritis, the supply of blood to the kidney is much decreased. The author has tried to restore normal capillary circulation in the diseased kidney by means of diathermy. Although this therapy is not causal, conditions of nourishment are created which promote the cure. It has been demonstrated by animal experiments that the temperature inside the kidneys is increased by the application of diathermy; the capillaries then distend, evidently in order to balance the surplus supply of heat. When nephritis was produced artificially in animals, the supply of blood to the injured kidney could not be restored by any diuretic though it could by diathermy. The author then used the method in three cases of serious acute nephritis in man with striking results. The patients were suffering from complete anuria; after the treatment by diathermy, diuresis set in and was followed by a cure in an astonishingly short time. A lead electrode about 30 cm. in breadth and 12 in. depth is applied in the renal region, a somewhat larger indifferent one on the abdomen. The contact with the skin should be made as complete as possible by means of bandages. Strength of current 1½ to 3 ampères, two sittings of about 2 hours each twice daily. — So far diathermy has only been recommended for the treatment of chronic renal diseases *(Nagelschmidt, Kowarschik)* but it was just with the most dangerous acute nephritis that the author observed the best results.—Ab. *Ars Medici*, 9:11, (January) 1931.

Physical Agents in the Treatment of Railway Injuries. Frank H. Walke.

Southern M. J., xxiii, 2:162 (Feb.) 1930.

Strains, sprains and contusions are treated with either heat or cold, while lacerations are first sterilized by ultraviolet light before surgery is attempted. Fractures and joint injuries are treated with splints, rest, diathermy, manipulation and massage augmented by the sinusoidal and galvanic currents. Nerve injuries yield better to rest, heat and the sinusoidal current. Burns of an extensive nature heal readily after light irradiation, but some are exposed to ultraviolet for its stimulating effect upon granulation tissue. Shock is admirably treated by diathermy through the splanchnic area, provided internal hemorrhage is excluded. Diathermy with the administration of an abundance of fluid is a valuable remedy for any surgical shock. Osteomyelitis is treated with diathermy and ultraviolet radiation after drainage has been established. Indolent ulcers are treated with radiant light, ultraviolet light and galvanism. Infections subside more quickly if ultraviolet light and the high frequency current are used. Painful stumps are best treated by hydrotherapy and the application of mild Tesla sparks to the sensitive areas.

The results obtained through physical therapy are speedy, certain and positive. Surgery can perform limited service only, and the surgeon's obligation does not stop with the healing of a wound, the uniting of a fracture or the restoration of a nerve. It is his plain duty so to conduct the case that the patient may resume his usual vocation or less be fitted to do some form of profitable work. The injured must be put back to work after a minimum loss of time. Should permanent disability follow an accident, rehabilitation should be hastened so that living wages can be earned even if the original occupation is not resumed.

High Electrical Resistance of the Skin of New-Born Infants and Its Significance. Curt P. Richter, Ph.D.

Am. J. Dis. Children, Vol. 40, No. 1, (July) 1930.

1. The resistance offered to the passage of a galvanic current through the body of a new-born infant is much greater than in adults.

2. The resistance of the skin on the backs of the hands (dorsal resistance), which is typical for the skin on the rest of the body, is very high. In some infants it is so high that the skin must be almost completely impermeable. It was pointed out how this high dorsal resistance reflects a high degree of muscular relaxation in the infant.

3. The resistance of the skin on the palms of the hands (palmar resistance) also is much higher than is found in adults. It was shown how the palmar resistance is correlated with the sleep of the infant; that is, the deeper the sleep the higher the palmar resistance.

4. The general significance of these observations in the understanding of the physiology of the new-born infant was discussed. It was shown how through the high palmar resistance the presence of an inhibition of the sympathetic and a possible dominance of the para-sympathetic is indicated in the new-born infant.

5. It was pointed out that according to previous results the high dorsal and palmar resistance would indicate a very small amount of insensible perspiration and sweating in the new-born infant.

Experimental Studies on Irradiated Ergosterol. C. Levaditi and Li Yuan Po.

Presse méd. **38:***168 (Feb. 5) 1930.*

In rats the mortality from the administration of irradiated ergosterol by mouth rose from 28 per cent at 1 mg. per kilogram to 100 per cent at 5 mg. In

rabbits the mortality began at 5 mg. and in kittens at 10.0 mg. The lesions were those found by other workers, namely, calcification of the aorta and intestines, with hepatitis and nephritis. In apes doses of 10 and 20 mg. per kilogram produced no trouble; when the animals were killed no histologic changes of any kind were found. This seemed remarkable to the authors, as apes are the nearest forms anatomically to human beings. They believe that with the care in dosage recommended by Hess, irradiated ergosterol may be used in the treatment for rickets and kindred diseases. Histologically they found that the middle coat of the aorta was affected, the calcium being deposited by fibroblasts and elastoblasts. They were not able to find a cause for the mechanism controlling this selectivity, but there were undoubtedly some animals that showed a predisposition. Further experiments are being undertaken.

Changes in the Acid-Base Equilibrium of the Blood in Rachitic Children Treated with Ultraviolet Rays. M. Giuffre.

Riv. di clin. pediat. **28**:*39 (Jan.) 1930.*

In twenty-seven children, from 7 to 42 months of age, with rickets, the author determined the hydrogen-ion concentration and alkali reserve of the blood before, during and after a course of treatments with ultraviolet irradiation.

There was no consistent change in the p_H of the blood. The alkali reserve, however, changed from what might be called a low normal to a high normal figure in most of the cases; in twenty-two cases, the alkali reserve increased, in two there was no change and in three the alkali reserve was less. Of the patients with lowered alkali reserve, one had syphilis and another tuberculosis; they showed no relief from rickets as the result of heliotherapy.

Use of ultraviolet Light in the Preparation of Infected Granulation Tissue for Skin Grafting. The Value of Very Thick Thiersch Grafts. W. D. Gatch and H. M. Trusler.

The Radiological Review, Vol. 53, No. 1, (Jan.) 1931.

By the methods we have employed, Thiersch grafts cut to proper thickness and successfully transplanted give a better result than do whole skin grafts.

The factors which render granulation tissue unsuited for grafting are cicatrix formation and infection.

Exposure to ultraviolet light is a valuable adjunct in the preparation of granulations. The surface must be beefy, red, vascular, and free from exudates.

Excellent results may be obtained by dressing the grafts under pressure with dry gauze, wool and elastic bandage.

For the grafting of small areas which will be subjected to trauma and for flexor folds about joints, we employ very thick Thiersch grafts. Joints should be splinted in full extension until all tendency to cicatrization has ceased.

Diathermy Treatment of Puerperal Septicaemia and Pneumonia. C. A. Robinson, M.B.

Brit. Jour. Rad. (August) 1930, p. 341, Vol. III.

The subject of electrotherapy has suffered in the past, and is still suffering from the want of sufficient test of the efficiency of our work. A knowledge of physics is essential but we are neglecting the empirical observation of the results upon definite disease entities.

Before an observation of a result can be considered fully carried out certain postulates must be fulfilled.

1. A definite diagnosis of the pathology must be made and the symptomatology must be constant for each disease entity.
2. An accurate record of progress of the case.
3. History of the case after cessation of treatment where possible.
4. The results of the treatment must be capable of being repeated in all cases where symptoms and treatment are similar.
5. Accurate record of amount of current, size of electrode, etc. There are two epoch making events in the history of modern electrotherapy. One was the advent of the first handy instrument for measuring the direct current. This was offered by Dr. Apostoli of Paris in 1880. The second was the coming of the diathermy machine. England saw its first diathermy machine in 1910.

Medical diathermy is divided into two groups thus:

1. Heating of more or less superficial structures to an indefinite temperature. This is given usually for local pain. The results are frequently good, but accurate observations cannot be carried out because the postulates mentioned above are not observed.
2. Heating of infected organs to a critical temperature. These included such cases as gonorrheal cervicitis, prostatitis, puerperal sepsis, etc.

The author describes the results in 21 cases of severe puerperal sepsis treated in this way. It is essential to have one electrode in the center of a circle formed by the other electrode. A lead belt around the pelvis and an intravaginal electrode were used. Only three deaths resulted and of these, the first was moribund before treatment, the second died of pulmonary embolism, and the third was a septicemia following abortion. Eight recovered after lysis, four by crisis and six after abscess formation. The author feels that without the aid of diathermy many more would have died.

Nineteen cases of arthritis presumably due to gonococcal cervicitis and urethritis were treated by diathermy of the cervix. Six were a complete success; nine were partial as far as the joints were concerned because bone destruction had already occurred; four were failures.

Gonorrheal vaginitis and urethritis can be cured by diathermy. Gonorrheal prostatitis does not show as many primary cures, but the effect on distant joint complications is just as good as the results seen in arthritis due to gonorrheal cervicitis.

Eighty-nine cases of pneumonia were carefully studied. Relief of pain and sedative action were universal. In delirious patients, however, these favorable results were not seen so frequently. The possibility of this being due to lack of co-operation

must be considered. The duration of the disease does not appear to be shortened. Treatments were given every four hours for twenty minutes. In pneumonia one electrode cannot be placed in the center of the other and that is why the results are not nearly so satisfactory.

Danger of Accidents in Physical Therapy. Stefan Jellinek.

Wien. med. Wochenschr., 1930, 80, Nr. 33, (August), p. 1084-1089.

In the practice of physical therapy four factors should be considered: Personality of the patient, surroundings, apparatus, methods. This is particularly true in electrotherapy. The tolerance of the individual to electricity is important. Some individuals can tolerate strong currents, while with others even the feeblest current causes ill-feeling, excitement, or anxiety. This tolerance or intolerance to electricity is also variable in the same individual and depends often on external (i. e., meteorological) or internal (i. e., physical) reasons. Frequently patients treated by electrotherapy do not completely undress; it is advisable to examine such patients before treating them, inasmuch as certain articles of wearing apparel, i. e., garters, that are partly made with metal may cause burns with a high frequency machine.

The location of the treatment room needs special attention. It should be free from ground-circuit; basement rooms, cellars with floors of concrete, xylolith or other well conducting covers are unfit for the installment of electrical apparatus. It is inevitable that the ground of every city nowadays is always in conducting connection with the net of strong current and that everybody takes part in this, if he is not isolated from the ground. This danger of connection with the ground is still increased by the fact, that the treatment room contains gas and waterpipes, radiators, etc. The apparatus for treatment should be placed free and as far as possible from the walls, because, according to modern construction concrete contains iron—a ready and dangerous conductor of the electric current. It is best to avoid any mounting of metal in these rooms. It is best not to have the transmission of the current performed in pipes (condensing water), but freely visible. Concerning the apparatus the author points out, that the "ground-free" apparatus in reality is only "ground free" as far as galvanization and "faradization" are concerned. Faradic current (by means of the inductor) which has no connection with the city's impact. The case is quite different with the current which is supplied by these connection apparatus for caustic and endoscopy. This current is not supplied by the transformer, but comes directly from the city net current wire intercalation of corresponding rheostats and therefore it is not "ground-free." Not only the diathermy apparatus but also the simple light baths and the electric heating cushions need medical control; as to the latter the importance of the protection against dampness in case of perspiration and use of wet compresses has to be emphasized.

Finally the author stresses the importance of correct technic.

Low Voltage T Waves in the Electro-cardiogram. Arthur M. Master.

Am. J. Med. Sciences, Vol. CLXXXI, No. 2. (February) 1931.

In 107 patients a study was made of low-voltage *T* waves, that is, flat *T* waves, in which the amplitude in any lead is not more than 1 mm.

The 12 patients that were examined postmortem all showed definite myocardial or pericardial damage. The clinical diagnoses in 7 cases were chronic myocarditis, general arteriosclerosis, coronary artery disease or arterial hypertension. Chronic rheumatic heart disease was present in 3 patients, tuberculous pericarditis in 1 and carcinoma metastases to the pericardium in another.

Another group of 12 patients died but no autopsies were performed. Eleven died with typical myocardial failure and 1 of pulmonary tuberculosis. Since the clinical diagnoses here were very similar to the group in which autopsies were performed, and the ages were practically the same, in all probability similar damage to the myocardium was present.

Altogether, there were 89 hospital patients with flat *T* waves, the mortality among those with degenerative cardiovascular disease was at least 44 per cent during the course of a three to four years investigation.

Acute rheumatic infection of the myocardium or pericardium often produces a flat *T* wave, and in the progression of the disease the *T* wave may become inverted, or, if the patient recovers, it will become upright. The rheumatic cardiac patient with a flat *T* wave is acutely ill and is probably always a bed patient.

The so-called "coronary *T* wave" or "cove-plane *T* wave" that is customarily associated with coronary artery occlusion may appear in a patient with rheumatic pericarditis.

Suggestive evidence has been presented that pericarditis alone, without disease of the underlying myocardium, may cause a flat *T* wave.

Flat *T* waves are practically always transitory, becoming inverted as the myocardial or pericardial damage spreads and increasing in amplitude on cure or improvement.

In pneumonia, bronchitis, exophthalmic goiter and syphilis the flat *T* wave appears to indicate a very severe form of illness. Nevertheless, the patients here studied all got well. As recovery or improvement takes place the *T* wave becomes normal amplitude.

Pleural effusions occasionally produce flat *T* waves.

A flat *T* wave is not uncommon in ambulatory patients. In a series of 18 patients of the latter type evidences of degenerative cardiovascular disease were present in almost 90 per cent. The flat *T* wave here was of serious import, indicating probably some severe degree of arteriosclerosis of the coronary arteries.

A flat *T* wave in only Lead I or II, although not as significant as flat *T* waves in all leads, is of some importance, since it suggests that on further observation the *T* wave may become inverted.

Radiation in Diseases of the Skin. Harold Swanberg.

The Radiological Review, Vol. 53, No. 1, Jan. 1931.

This is a compilation of the uses of radiation in diseases of the skin. Of roentgen-ray therapy, the author states that they are now considered the most useful and successful single remedy available for the treatment of skin diseases. In eighty-one dermatoses roentgen radiation is applied with various degrees of benefit. The contraindications and indications are listed and the limitations and abuse of x-ray treatment cited.

Regarding radium therapy, its limited field of usefulness is mentioned. The utility of radium is definitely established in an important group of skin diseases, which includes the many types of cancer of the skin, precancerous lesions, vascular nevi, keloids, keratoses, verrucal, keratodermas, leukoplakia, lupus erythematosus, lupus vulgaris, krauosis vulvae, and vernal catarrh. Aside from the palliative value in advanced cases of malignant disease, the scope of radium therapy has gradually broadened so that it is now given preference in the treatment of the primary growth of some types of cancer while in the operative stage. There is probably no difference between x-rays and radium, except that with radium we are apt to use heavier filtration than we do with x-rays, and are therefore certain to get sufficient penetration. A good dose of radium is better than a poor dose of x-rays and vice versa.

Radiumtherapy in Diseases of the Blood. N. Jagic.

Wien. klin. Wochenschr., 1930, H. 3, Nr. 23 (June), p. 705-708.

A cure of leucemia and lymphogranulomatosis is impossible; it is even doubtful whether a substantial prolongation of life can be attained by radium therapy. Nevertheless one should use radium therapy if it is desirable to reduce swelling of the spleen, the liver and the lymphatic glands, especially when the swelling causes compression of neighboring organs, i. e., the trachea, or severe pain by pressure on nerves.

Jagic applied radium instead of the usual x-ray radiation in several of his cases and found that the swelling of spleen and glands diminished much slower, the blood picture improved much slower too, but the general condition improved remarkably promptly. The absence of any signs of disturbance during the time of treatment with radium is emphasized. Jagic therefore recommends heavy x-ray radiation in urgent cases, i. e., large tumors of the mediastinum, either of leucemic or lymphogranulomatic origin, which tend to compress the trachea and bronchus. In cases where one wants to have swelling of superficial lymph glands disappear, either leucemic or lymphogranulomatic, radium therapy is preferable because there is no disturbance of the general condition. In advanced cases with anaemia and cachexia the treatment with radium tubes is to be preferred as it causes immediate general improvement, is safe and especially stimulates the appetite. Another advantage of the radiation with radium is the fact that it can be done at the patient's home.

High Frequency Currents in Tuberculosis of the Bladder. P. Costesco.

Jour. d-urol., 30:265. (September) 1930.

High Frequency Currents in Tuberculosis of the Bladder, notes that not infrequently tuberculous lesions persist in the bladder after the removal of the tuberculous kidney, and in such cases the bladder lesions require treatment in order to relieve the symptoms of frequency and pain. In such cases the author has used the high frequency current employing the Oudin monopolar current according to the Heitz-Boyer's technique first described in 1913. With this current the electrode is brought close to the lesion, but not in direct contact, so that the sparks are short and hot. This method of fulguration the author has found superior to electrocoagulation, especially in tuberculous ulcerations of the bladder, where it is necessary to limit the destructive effects of the high frequency current in order to avoid perforation. A cystoscopic examination is made prior to treatment and the capacity of the bladder determined. For the fulguration treatment, anesthesia is used because of the irritability of the vesical nervous system. Preferably local anesthesia is employed, but in very sensitive patients either general or spinal anesthesia may be used. In many cases of single fulguration treatment is sufficient to heal the vesical lesions and relieve symptoms. In some cases with multiple lesions several treatments are necessary. The interval between treatments should be fifteen days. The fulguration treatments cause no febrile reaction, and very little, if any, bleeding. In some cases of ulceration the lesion is covered by a heavy false membrane after the fulguration treatment. A second treatment should be given in these cases after the usual interval (fifteen days). The cicatrization of the lesions is usually not complete until toward the end of the fourth week, but the relief of symptoms is noted immediately after treatment. Pain and frequency of urination are reduced; the urine becomes free from pus (unless there is secondary infection) and the capacity of the bladder is increased (unless the lesions were very extensive).

Experimental and Applied Studies in Electrosterilization. Louis I. Grossman, D.D.S. and J. L. T. Appleton, Jr., B.S., D.D.S.

The Dental Cosmos, Vol. LXXIII, No. 2. (February) 1931.

The antibacterial effect of several solutions advocated for use in the treatment of periapical infection by electrosterilization was determined *in vitro*. Oral bacteria and a clinically tolerated dosage of current (thirty milliampere-minutes) were used. A standardized technique was developed and followed. The results of this study are as follows:

(1) Greater antibacterial effect was uniformly obtained from an electrolyzed chemical solution than from the same solution without electrolysis.

(2) The antibacterial effect was always distinctly greater at the positive pole.

(3) Zinc iodid has a greater antibacterial action than potassium iodid.

(4) About fifty electrolyzed chemical solutions were tested for their antibac- $\frac{M}{1}$ — with iodin 0.1 M. This solution is recommended for clinical use in electrosterilization of root canals.

(5) Several chemical solutions were examined for their irritant action on the exposed subepithelial tissue of a rabbit. These solutions were electrolyzed for about thirty milliampere-minutes. Observations extending over a sufficiently long period of time show that a solution of zinc iodid $\frac{M}{1}$ with iodin 0.1 M has no greater irritant action than an electrolyzed solution of sodium chlorid (0.85 per cent), or solution No. 3, or Lugol's solution.

(6) The zone of sterility is not due to a change in the degree of acidity of the culture medium effected by the electrolytic process, but is due directly to the action of the electrolyzed chemical.

(7) The bacteriologic effect obtained by electrosterilization is bactericidal.

(8) A description of the physico-chemical changes in the electrolytic process is advanced.

The Treatment of Ocular Tuberculosis by Means of Roentgen Rays. J. Urbanek.

Brit. J. Actinotherapy, 1930, **5**, *No. 8, 169.*

Up to the present time we have no uniform dosage as regards the kind or quantity of Roentgen ray to be used in treatment of diseases of the eye. Following the advice of Rohrschneider regarding the standardization of dosage Urbanek applied Roentgen rays to tubercular diseased eyes. Reporting on the result of 50 cases treated in the first University Eye Clinic, Vienna, he found improvement in only 3 of 20 cases of chronic iridocyclitis. These cases had both eyes affected and only one eye was radiated. In this way he was able to observe in all 3 cases that a more rapid favorable termination of the process took place upon the eye which had been radiated. The results in scleritis were thought to be very good, but in one case when both eyes were involved the radiated eye showed no more rapid improvement than the other, though with "tebeprotin" a rapid cure was obtained in both eyes. In *old* cases of choroiditis no beneficial results were obtained. On the other hand Roentgen ray treatments of fresh cases gave most excellent results. The result of treatments in cases of keratitis also were very good. In recurring hemorrhages in the vitreous humor no success was obtained. The treatments given in Professor Holzknicht's Institute were with 1½ H. to 2 H. through a filter of 0.3 zinc, unless there was need for especial care on dosage. The dose corresponds to approximately 18 per cent of H:E.D. The highest dosage given was 25 H., divided into 14 radiations, spread over a period of nine months. The first radiations were given at intervals of eight days; then came intervals of four to six weeks.

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